NATIONAL MUSEUM MELBOURNE

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The Journal of the Department of Agriculture of Victoria, Australia.

August, 1924.

PRINCIPAL CONTENTS

Wheat and its Cultivation

The Production and Flue-Curing of Tobacco

Apricot Growing

Potato Manuring Trials

Maffra Crop Competitions

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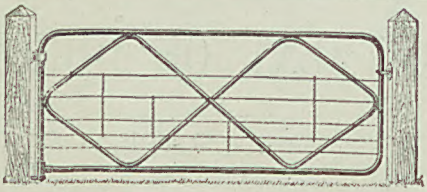

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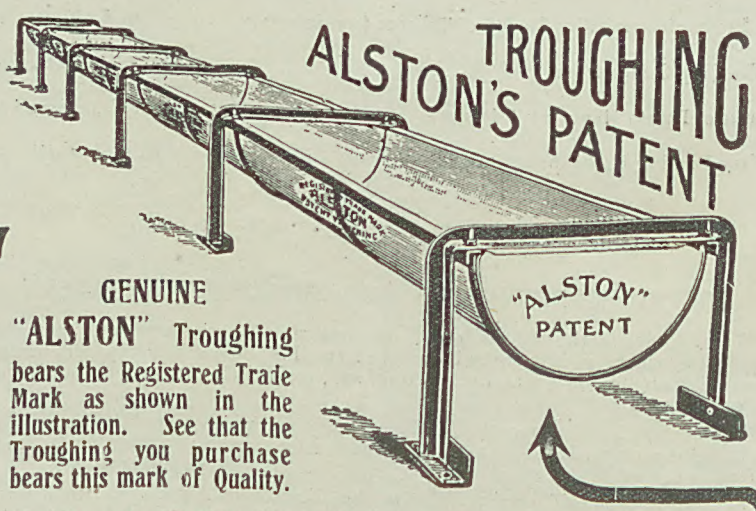

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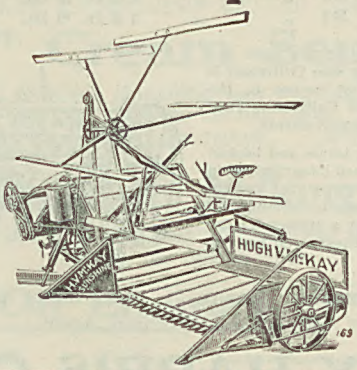

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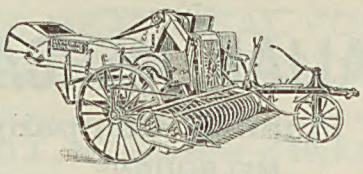

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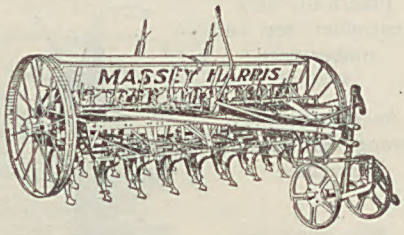

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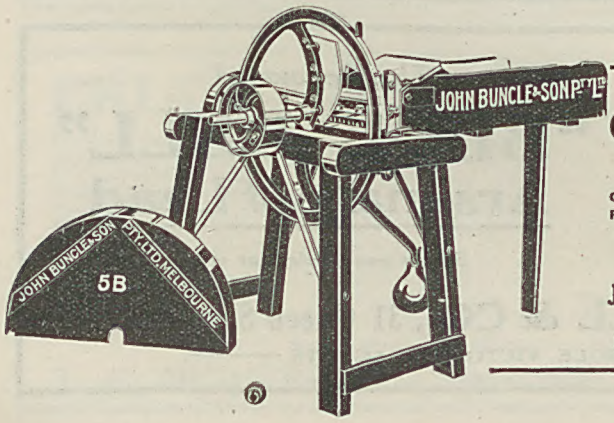

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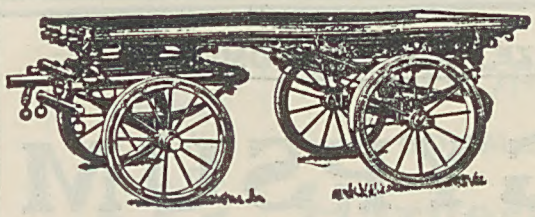

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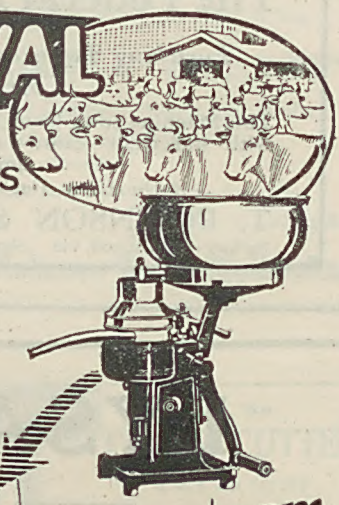

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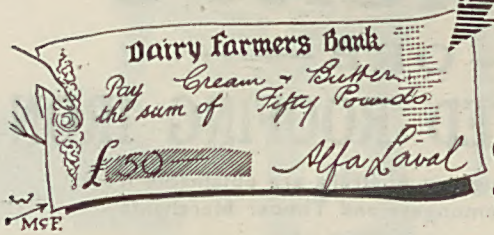

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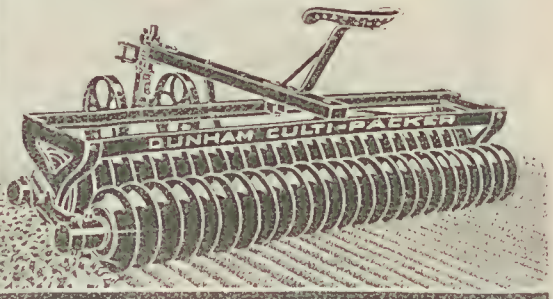

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NATIONAL MUSEUM MELBOURNE

WHEAT AND ITS CULTIVATION.

(Continued from page 414.)

By A. E. V. Richardson, M.A., D.Sc., Agricultural Superintendent.

SEEDING OPERATIONS.

No activities on the farm arouse such speculation and anxiety to the Australian wheat-grower as those pertaining to seed operations. The nature and peculiarities of the Australian climate are such as to render a close study of the factors underlying successful seeding imperative. In some of the more favored countries of Europe the distribution of the rainfall is so even throughout the year that the wheat-grower may sow wheat at his leisure in autumn; or, if weather conditions be unfavorable for autumn seeding, he may defer operations until the advent of spring, and still secure a heavy crop.

Spring sowing of wheat would inevitably lead to failure in the Australian wheat belt, owing to the uncertain character of the early summer rains and the protracted dry summer. The bulk of the rain falls between April and October, the period when the southern portion of Australia is dominated by the Antarctic low pressure areas. During the summer months the northern portion of Australia is affected by monsoonal low pressure areas, and the southern portion of the continent receives only sporadic thunderstorms.

Autumn-sowing or early winter-sowing must therefore be regarded as essential for successful cropping over the greater part of the wheat belt. Wheat-growers in the drier districts have learned from long experience that in the great majority of seasons the success of the crop depends very largely on getting the seed sown on soil in good physical condition

at the right time—within what may be called the normal seeding period, which, under the most favorable conditions, extends over some six or eight weeks.

When heavy showers fall intermittently during this period, as in 1923, the seeding is considerably delayed, and much of the crop must be sown too late to secure optimum results.

When large areas are to be sown and difficulties arise from dearth of labour or teams, the sowing season must be prolonged beyond the period necessary to secure the best results.

Late autumn is the most favorable time for seeding, and the actual date to commence operations will vary with the district and the general character of the season. Much, of course, depends on the weather. In some years the Antarctic rains begin late in the season, and the seeding begins in the dry seed bed. In other years the autumn rains are timely, frequent and copious, and the seed is sown under conditions which bring about a rapid, even and vigorous germination.

In some specially favored areas, e.g., the grey soils of the Wimmera, seeding is rarely begun till June, and much of the wheat is sown in July. Indeed, experience has shown that late sowing is decidedly advantageous on these grey soils.

At the Longerenong experimental plots the average yield of six varieties of wheat sown late (July) was 39.1 bushels per acre over an eight-year period, compared with 34.4 bushels for the same varieties sown early (June), i.e., an increase of 14 per cent. in favour of late sowing. It was found that on these grey soils early sowing produced tall, leafy crops, with a relatively low percentage of grain to total dry matter, whereas the late-sown crops were shorter and bore a higher proportion of grain to straw. These soils, however, are very retentive of water, and are of great depth and fertility, and the thorough methods of cultivation in vogue in these areas result in the conservation of much soil moisture. They respond to cultivation, and do not form a hard crust owing to their high content of carbonate of lime and organic matter.

The red soils of the Wimmera are far less amenable to tillage operations, and readily run together with the heavy rains. Unlike the grey, they do not respond to late sowing, which in wet winters is decidedly detrimental.

May is the most favorable month for seeding over the greater part of the wheat belt. At this time of the year the soil temperatures are still high, and usually the first Antarctic rains have thoroughly moistened the surface layers of the soil. No time should be lost at this period of the year. The fallows should be ready for the sowing of wheat after the first soaking rain in late April or May. One great advantage of fallowing becomes obvious to the wheat-grower at this period of the year. When the first winter rains completely moisten the soil he is able, with fallowed land, to concentrate all his team strength on the cleaning of the land and sowing of the seed.

Many farmers in their anxiety to get over large areas frequently begin seeding before a definite break in the weather occurs. One of two things may happen; dry weather may continue after the seed is sown; in which case a considerable amount of the seed may be lost through malting, and re-sowing may be necessary. On the other hand, timely showers may supervene and bring the young plants on with

exceptional vigor, the result of which is rank heavy growth. Such forward crops are likely to be cut later by frosts, and they also tend to lodge with the heavy winter rains.

It is often advantageous to administer a check to the rapid growth of early-sown crops by judicious feeding down with sheep. Such grazing is usually beneficial, provided the sheep are not allowed to remain too long on the crop.

The malting of the seed through early sowing on dry soils may be serious. Wheat and other naked seeds are very prone to malting, whilst oats and barley, protected as they are by their tough fibrous husks, are much less susceptible. Oats and barley may therefore be sown without much fear of loss. There is, however, always a danger in sowing wheat on dry soil, for it may contain sufficient moisture to induce germination, but insufficient to carry the young plant until a break occurs in the weather. In these circumstances the grower may be compelled to re-seed his crop. For these reasons the wheat-grower usually waits until a break in the weather occurs, for while the seed bed is dry, the seed is safer in the barn than in the soil. In some seasons, when the winter rains are delayed, and the season is advancing, the grower will take a risk and commence seeding under dry conditions, especially where the area to be seeded is large.

Though, as already said, May is the most favorable month for seeding in the drier districts of the State, in the more favored districts there is not the same urgency for early sowing. Farmers in these latter areas usually wait for the break in the weather, and prefer to give the land some cultivation after the rain has started the rubbish and weeds. The spring and early summer rains there are usually favorable, and late-sown crops often materially benefit by these rains. In the Mallee areas, however, the spring rains are erratic and frequently light, and in these circumstances crops which are well forward and approaching maturity by the time the hot, dry weather sets in, i.e., the early-sown crops, yield better than those sown late.

On the whole, early sowing is the best policy for light rainfall areas, so that the wheat crop may have as long a period of growth as possible before the hot, dry winds, so prevalent in October and November, set in. In the more favored districts the seeding may be more protracted, whilst on certain types of soil, e.g., the Wimmera grey soils, relatively late sowing appears to be a decided advantage.

Varieties to Sow.

The choice of varieties is determined by the climate, the soil and the purpose for which the wheat is required. The difference between the yield of two varieties of wheat grown on the same farm under identical conditions is often sufficient to more than pay the rent on the land on which the crop is grown. This has been frequently demonstrated in departmental experiments.

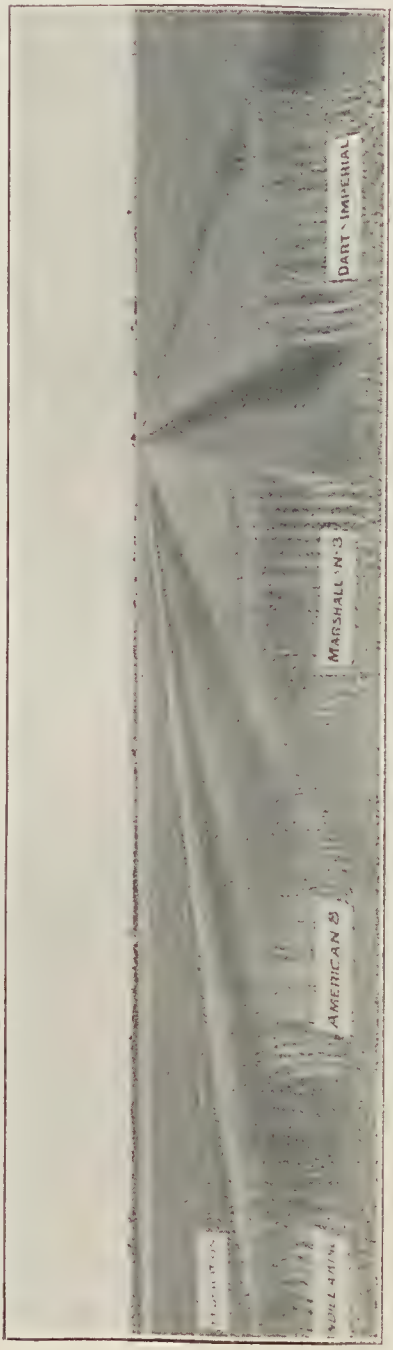
The farmer should select varieties which are profitable under his soil and climatic conditions. A large number of variety wheat plots have been conducted in various parts of the state, and the results of these are very helpful to the farmer in deciding what varieties he should grow.

Owing to the variableness of the seasons varieties that do well one year may make a miserable showing in the following year. If seasons were uniform in character the choice of varieties would be a simple matter.

In the drier areas, in normal and dry years, the early-maturing varieties generally give best results. In districts with liberal rainfall and with a protracted growing period, late-maturing varieties invariably give the best results.

Some wheats of outstanding excellence, e.g., Federation, do well under a wide range of conditions, but most of the varieties grown in Victoria have a more limited range of usefulness. Federation wheat has done remarkably well under Wimmera conditions, especially on the grey soils. Indeed, on many Wimmera farms practically the whole of the area is seeded to this deservedly popular variety. Its habit of growth, period of maturity, and its high yield of grain in relation to straw when sown late, combine to make it a suitable variety for the peculiar soil and climatic conditions of the Wimmera.

Milling quality in wheat does not usually influence the farmer in his choice of variety. His main aim is to secure a wheat which will yield well on his farm. Varieties of high milling quality have not hitherto been prolific wheats. Hence, unless the wheat-grower received some encouragement in the form of a premium for such wheats he has been disinclined to grow them.



View of Variety Wheat Plots showing Method of Testing Yielding Capacity of Varieties.

The farmer has a large number of varieties to select from. Among those most suited to Victorian conditions are the following:—

1. *Grain Varieties*—

   Early.—Bunyip, Canberra, King's Early, Mac's White, Steinwedel, Ranee, Rajah, Gluyas.

   Midseason to Late.—Federation, Yandilla King, Currawa, Major, Dart's Imperial, Gallipoli, Marshall's No. 3, Wannon, Graham.

2. *Hay Varieties*—

   Warden, Firbank, Baroota Wonder.

The qualities of these varieties will be described later.

Rate of Seeding.

The amount of seed to be sown varies within very wide limits, and is governed by several considerations. The amount of seed required varies with—

1. *Climate.*—The lower the average rainfall of the district, the less seed is required. The minimum is required in dry, Mallee districts, the maximum in wet, humid districts.
2. *Time of Sowing.*—Early-sown wheat requires less seed than the same variety sown late. As the seeding progresses it is well to gradually increase the amount sown, since late-sown wheat has much less opportunity to stool out and establish itself before the winter sets in than the early-sown wheat.
3. *Character of Seed Bed.*—Early sowing on clean land requires the minimum. Land, foul with weeds, must, if it has to be used, be sown thickly to give the wheat an opportunity to choke the weeds.
4. *The Character* of the wheat, its stooling capacity, the size of the grain, whether it is an early or late maturing variety, and its germinating capacity. Obviously all these influence the amount of seed required.
5. *The Use* to which the wheat is put—whether for grain, hay, green forage or ensilage. The minimum will be required in the former case; the maximum in the latter.
6. *Method* of sowing—whether drilled or broadcasted. About 20 to 25 per cent. more seed is required with the broadcaster to give the same braird as the drill.

With these reservations it may be said that the average amount of seed used in the Mallee for grain is 40 to 60 lbs.; in the Goulburn Valley, 60 to 80 lbs.; in the Wimmera, 65 to 90 lbs.; and in the Western District, 70 to 90 lbs.

The usual practice is to commence the seeding season at the lower limit, and to increase the rate of seeding and manure as the season advances. When the wheat is grown for hay or forage heavier seedings are given.

The effect of the rate of seeding on the yield of early and late-sown wheat in the Wimmera is shown in the following table, which summarizes the results of the ten years 1914-1923:—

Table Showing Effect of Rate of Seeding on the Yield of Early and Late-sown Federation Wheat, Longerenong Agricultural College, Seasons 1914-23.

Rate of Seeding Per Acre.	Yield Per Acre.	
	Early Sowing.	Late Sowing.
lbs.	bush.	bush.
45	34·9	40·3
60	37·9	40·4
75	38·5	43·5
90	37·3	43·3
120	37·7	42·2

For the past eight years, six varieties of wheat were sown during the normal seeding period (May), and also during July (late sowing), on Wimmera grey soil at Longerenong. The results are summarized in the table:—

Showing Results of Early and Late Sowing of Six Varieties of Wheat on Black Wimmera Soil, Longerenong Agricultural College, Seasons 1916-1923.

Variety.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	Average for eight years.
Early-sown Plots.	bush.	bush.	bush.	bush.	bush.	bush.	bush.	bush.	bush.
King's Early ..	28·6	37·8	32·0	24·1	32·9	28·3	19·3	53·6	32·1
Bunyip	18·6	38·4	28·1	20·6	26·0	26·6	19·4	39·3	27·1
Federation ..	29·9	48·2	42·2	32·1	28·3	47·0	39·0	57·3	40·5
Yandilla King ..	32·9	36·5	32·5	28·3	36·6	39·6	36·6	52·9	37·0
Marshall's No. 3 ..	29·9	38·4	34·6	10·6	32·0	36·0	33·6	57·3	34·1
Dart's Imperial ..	27·1	39·7	30·3	23·0	20·6	42·0	35·2	49·3	33·5
Average of Early-sown Plots ..	27·8	39·8	33·2	23·1	29·4	36·5	30·5	51·6	34·4
Late-sown Plots.									
King's Early ..	7·4*	41·6	39·0	26·9	40·0	46·6	36·0	56·0	36·7
Bunyip	20·1	39·3	30·7	22·6	38·6	44·6	34·7	48·0	34·9
Federation ..	42·7	43·9	44·2	24·0	48·6	42·9	43·4	62·3	45·3
Yandilla King ..	32·5	41·6	31·4	20·8	51·3	49·6	41·8	67·6	42·1
Marshall's No. 3 ..	25·6	38·4	37·0	22·0	42·0	42·0	35·5	66·0	38·5
Dart's Imperial ..	30·5	37·0	37·4	22·3	38·0	44·0	36·8	53·3	37·4
Average of Late-sown Plots ..	26·4	40·3	36·6	23·1	43·0	44·9	38·0	58·8	39·1

* Crop lodged and shelled badly on account of heavy December rain.

These results demonstrate the value of late seeding for the Wimmera grey soils. Early sowing on these soils produces a tall, leafy crop with a relatively low percentage of grain to total dry matter. Late sowing

produces shorter crops, with a higher percentage of grain to total dry matter. The difference in yield was 14 per cent. in favour of the late-sown plots. The optimum quantity of seed for early sowing on the Wimmera grey soils is 75 lbs. per acre, and for late sowing, from 75 to 90 lbs. If more or less seed is used the average yields are considerably depressed. As already indicated, these Wimmera grey soils are very retentive of water, amenable to cultivation, and of considerable depth and fertility. Moreover, the thorough methods of cultivation practised on these soils lead to the conservation of much soil moisture. The red soils are far less amenable to tillage operation and run together readily with the winter rains. These soils do not respond, like the grey, to late sowing.

Method of Sowing.

The drill is now generally used in Victoria for sowing wheat. During recent years the combine-drill has made its appearance. With this type of drill, the soil is cultivated at the same time as the seed is sown, and sowing on a reasonably clean seed bed is thus assured.

These drills have become popular in the Wimmera and parts of the Mallee. They represent an interesting development in the application of labour-saving machinery to the farm, as the teamster and team will cultivate and drill the land in one operation.

Broadcasting is rarely practised nowadays. The advantages of the drill easily outweigh those of broadcasting. With the drill, seed and manure can be sown together in the one operation. The roots of the young plant easily find the fertilizer, and early growth and vigorous root development are stimulated. The weeds between the drills do not derive the same advantage from the fertilizer as the wheat plant does. The drill is more economical with seed, and the amount of seed sown is easily regulated. Germination is regular owing to the uniform depth of sowing, and the depth of sowing may be regulated to suit the seed bed.

The seed and fertilizer should be carted to the headland of the field to be sown, and placed in such a position that they suit the drill for filling. The paddock is best drilled backwards and forwards across its greatest length, as this makes it easier to judge the supplies of seed and fertilizer required, and also the area sown. Sufficient fertilizer and seed should be put in the drill, or carried on the drill, to go at least one complete round, so that the supply will not run out before returning to the headland. The inside hoe of the drill should sow in the wheel track made by the previous round.

The depth to sow the seed is important. Light-textured soils allow of deeper sowing than those of fine texture. With deep sowing there is risk of consolidation if rain falls just after sowing, and the wheat comes away unevenly. Deep sowing does not assist deep rooting. Generally speaking, from $1\frac{1}{2}$ inches to 2 inches will be the best depth at which to sow seed, though, if possible, it should be deposited in the moist soil below the dry surface layer.

Treatment of the Seed.

(1) *Is change of seed necessary.*

There is a notion, very prevalent among wheat-growers, to the effect that change of seed at periodical intervals is more or less necessary. It is very difficult to obtain even from those who hold this view most

stoutly, the reason for their belief. Perhaps the most obvious reason lies in the farmers' expressive phrase that the "wheat has run out." This is an expression of the belief that the continued cultivation of the same variety of wheat under the same soil conditions for a number of years results in the deterioration of that particular strain of seed to such an extent as to render a change absolutely imperative. In other words, it is the practical farmer's expression of the belief that varieties of wheat, under ordinary conditions of cultivation, tend to degenerate. Such a view is by no means new. It dates back at least to Roman times, for in the Georgics, Vergil tells us—

> "Unless the peasant with his annual pain
> Renews his choice, and selects the largest grain,
> Thus all below, by Nature's curse,
> Or Fate's decree, degenerates still to worse."

It is difficult, indeed, to see how, if careless and slipshod methods of cultivation are practised, and no care taken to preserve the very best of the crop for the next season's seed, the prolificacy of any given variety of wheat can be maintained at a high level. It is still more difficult to see how such a grower can improve matters by securing a change of seed from persons equally careless as himself. *Unless the change be for the purpose of obtaining a better variety, or more vigorous seed, or for seed that has been subjected to careful and continued systematic selection, there can be no advantage resulting from change of seed.* The balance of evidence goes to prove that farmers should rely on locally-developed seed, and should give more attention to their own seed, and the prevalent idea that *mere change of seed* gives good results would appear to be founded more on opinion than upon well ascertained fact.

Provided reasonable case is given to the production of seed, there is no reason why the yielding capacity of wheat may not be indefinitely maintained at a high level, even if it is grown continuously on the same farm.

Each progressive grower must of necessity be an experimentalist, constantly observing and testing the behaviour of the varieties grown on his own farm and in his district. The poorer varieties are thus gradually eliminated, and the best varieties retained for the bulk of the farm area. Having determined the most suitable variety or varieties for the farm conditions, deliberate steps should then be taken to improve these chosen varieties by systematic selection and regular grading.

Grading the Seed.

The belief that shrivelled, pinched grain was as good as plump grain for seed purposes was very commonly held some years ago. Carefully-conducted experimental work has demonstrated beyond doubt, however, that plump grain is greatly superior to shrivelled grain in productive power.

At the Ontario Agricultural College, Canada, Zavitz conducted some interesting experiments extending over six successive years with winter wheat, and eight years with spring wheats. Large plump grain of winter-sown wheat gave 46.9 bushels per acre, as against 39.1 bushels from shrivelled grain of the same variety, i.e., 7.8 bushels per acre extra. Again, with spring wheats, the difference amounted to 5 bushels in favour of graded grain, the large plump grain yielding 21.7 bushels, whilst the shrivelled grain of the same variety gave 16.7 bushels.

An experiment conducted by the Victorian Department shows clearly the effect of grading the wheat on yield. Federation seed was passed through a Mayer grader, and four samples of grain shown in Plate I. were obtained.

A sample of the seed just as it came from the harvester was reserved for a control plot and labelled "Normal seed." It consisted of grain of varying size, containing chaff, stems, and a small proportion of cracked and pinched grain. The grader separated the wheat into four grades. Of these the first grade consisted of fine plump grain of

Grade I.

Grade II.

Grade III.

Normal.

Plate 1.

about uniform size. Grade II. was slightly smaller in size, but uniform and fairly plump. There were very few defective grains. Grade III. consisted for the most part of small grain, approximately half of which was somewhat pinched, and a small proportion of cracked grain. Grade IV., which consisted of white heads, chaff stems, cracked and pinched grain, was rejected.

Equal quantities of the grades, Normal, Grade I., Grade II., and Grade III., were sown with the drill at the rate of 49 lbs. of seed and 81 lbs. of superphosphate per acre.

The average weight and volume of each sample of grain, and the yield per acre, were determined. The results were as follow:—

Table Showing Average Weight, Volume, Density, and Yield per Acre of Graded Seed.

Grade of Sample.	Average weight per kernel.	Average volume per kernel.	Specific gravity of seed.	Yield per acre.	
	grams.	c.c.m.		bush.	lbs.
Normal (from harvester) ..	·0311	·023	1·33	25	27
Grade I.	·0397	·029	1·36	28	6
Grade II.	·0288	·022	1·30	27	53
Grade IV.	·0197	·015	1·27	23	50

From the results of this experiment it is evident that grain obtained from the harvester may be divided into at least three grades of seed, of which two grades give yields considerably in excess of the normal seed, whilst the yield of the third grade is considerably below that of the Normal seed.

Grade I. gave an increased yield of 2 bushels 39 lbs. per acre over the ungraded seed, which at 4s. per bushel equals an increase of 10s. 8d. per acre. Similarly, Grade II. gave an increase of 2 bushels 26 lbs. per acre, or 9s. 9d. per acre over the ungraded seed.

On the other hand, Grade III., which consisted mostly of pinched grain, with a small proportion of cracked grain, gave a decreased yield of 1 bushel 37 lbs. per acre, that is a loss of 6s. 6d. per acre compared with the ungraded plot. Hence, for the trifling expenditure of, say, 6d. per bushel—the cost of grading the seed—less than 6d. per acre, the grain from the harvester may be separated into three distinct grades of seed, two of which give increased yields worth 10s. 8d. and 9s. 9d. per acre, and a low grade sample which would normally be reserved for the poultry and the pigs.

But there are other advantages accruing from grading of seed wheat besides the increased profit obtained per acre.

An ordinary sample of grain from the harvester always contains a proportion of cracked and broken kernels. The actual amount will vary with the skill of the harvesting operator, and with the setting of the machine.

This cracked and broken grain has little or no value for seed purposes, since it either will not germinate, or, if it does germinate, it gives rise to spindly weak plants of low productive power. This grain is, however, of value for feed purposes. Now, by the process of grading, the grain of considerable commercial value for feed, but of negligible value for seed, is separated and saved. The saving thus effected will more than cover the cost of grading, apart altogether from the higher productive value of the graded product.

If to these advantages we add that the use of a good grader will separate weed seeds, grains of other cereals, and remove rubbish, diseased and damaged grain, and steadily improve the quality and prolificacy of the seed each year, it will readily be admitted that the advantages accruing are sufficient to justify the cost of installation of

a good machine on the farm. The capacity of many of the machines now on the market is such that the whole of the seed required for the seeding of a farm of average size may be graded in a few days. Under these circumstances it would seem feasible for a group of farmers to co-operate in the purchase of such a machine, and use it in rotation after harvest. As an alternative, arrangements might possibly be made by country flour mills to install a machine, and undertake at a nominal cost the grading of seed for the farmers in the vicinity.

TREATMENT OF SEED FOR BUNT OR STINKING SMUT (*Tilletia tritici*).

Historical Development of Treatment for Bunt.

Bunt in wheat has been known from the very earliest times. Theophrastus and Pliny both refer to this disease in their works. Tillet in 1755 sowed seed artificially infected with bunt spores alongside clean seed, and showed that the infected plants were badly attacked with bunt, while the clean seed produced a crop free from infection. He thus definitely demonstrated experimentally the infective character of the disease.

Kuhn was the first to show (1858) that the bunt was caused by the entrance of fungus threads through the leaf sheath of the young germinating wheat plant.

In 1874 he stated that infection could occur at almost any point in the seedling wheat. Although the use of bluestone (copper sulphate) for the control of bunt was first suggested by Schulthess in 1761, Kuhn was the first to suggest a formula for its use. He recommended the use of a $\frac{1}{2}$ per cent. solution, and immersion of the wheat in the solution for twelve hours. In 1888 Jensen suggested the hot-water treatment of seed (132°F. for ten minutes) for the prevention of cereal smuts. The use of Formalin as an antiseptic for smut was first suggested by Geuther in 1895.

Maddox, of Tasmania, was the first to demonstrate that loose smut of wheat (*Ustilago tritici*) was caused by infection of the blossom, and this established a fundamental difference between loose smut of wheat and stinking smut.

Farrer conducted a large number of experiments on the control of smut from 1900 to 1903, and attempted to breed bunt-resistant wheat varieties by thoroughly infecting the seeds of many varieties and cross-breeds with spores of smut, and selecting year after year the plants immune from attack.

Remy and Vasters in 1914 carried out extensive investigations with Uspulun—a proprietary preparation in which the active principle is chlorophenate of mercury. Seed immersed in a $\frac{1}{4}$ per cent. solution for one hour gave perfect control of bunt without injury to the seed.

In 1918, Darnell Smith, of New South Wales, recorded the results of three years' experiments in the use of dry powderd copper carbonate as a seed treatment for bunt prevention. They showed that copper carbonate was a most effective fungicide, and that it stimulated germination and led to increased wheat yields. Powdered copper carbonate has been thoroughly tested in the United States and in Australia, and the investigations show that it is a very effective fungicide for bunt control.

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Theory of Bunt Control.

Bunt is caused by a fungus which reproduces itself by small bodies called spores, which are analogous to the seeds of the higher plants. This bunt fungus is parasitic in its growth, and attacks the wheat plant just when germination takes place. The mycelium of the fungus then penetrates the wheat plant, lives on its host, grows with it, and ultimately produces myriads of spores which collectively form the "bunt balls" of the infected heads.

The methods hitherto adopted for bunt control involve immersing the seed in solutions of formalin (formaldehyde gas dissolved in water), or bluestone (copper sulphate) of a strength sufficient to kill all bunt spores adhering to the seed without materially affecting the vitality of the wheat seed.

If the solutions used are too weak the smut spores will not be killed. If the solutions are too strong the germ of the wheat will be injured, and in such a case the germination of the grain will be considerably lowered and the growth of the young seedling retarded.

It is found in practice that solutions sufficiently strong to kill all spores of smut invariably have an injurious effect on the vitality of the seed. This is reflected in a poorer germination of the pickled seed, and in slow growth of such seeds as are unaffected by the antiseptic solutions. Hence we find under field conditions that seed pickled with solutions of bluestone and formalin usually show a poorer germination and delayed germination compared with untreated seed.

The extent to which the germination is affected by the fungicidal solutions depends on the strength of solution, the time of immersion, the moisture content of the soil at the time of seeding, and the time which elapses between the pickling of the seed and the sowing of it.

Smut may occur in seed in two forms, (1) in loose spores adhering to the brush and in the crease of the grain, (2) in the form of bunt balls. Pickling in sacks kills all the loose spores adhering to the grain. The time during which the seed is immersed in the pickle may be insufficient for the complete peneration by the antiseptic solution of the walls of the bunt ball, and for the complete wetting of the mass of spores enclosed in the bunt ball. When such a sample of seed is sown reinfection may occur.

Hence in some pickling machines, e.g., Bishop's, McCabe, and others, provision is made for running the seed in a stream into the antiseptic solution. By this means the light bunt balls separate from the mass of wheat, float on the surface of the pickling solution, and are skimmed off. In this way even a badly-smutted sample of grain may be made safe from reinfection.

Methods of Controlling Bunt.

The methods used for controlling bunt are:

(1) Hot water method, (2) Use of fungicides.

Hot Water Treatment.—This has been recommended at various times, but, in practice, though the treatment is efficient, the method is very cumbersome, slow, and unwieldly. The method consists in immersing the seed for ten minutes in hot water at a temperature of 130° to 132° F The practical difficulty is to keep the temperature constant. A considerable lowering of temperature results immediately the seed is introduced, but this may be avoided by pre-heating the seed in a vessel of water, the temperature of which is approximately 130° F., before

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immersing it in the main bath. It is a method, however, which requires skilful handling and careful supervision.

It is effective for Loose Smut of wheat (*Ustilago tritici*) as well as for Bunt (*Tilletia tritici*).

Fungicides.—The three fungicides most extensively used are: (1) Formalin, (2) Bluestone, (3) Powdered copper carbonate.

An ideal fungicide for pickling purposes would require to be (*a*) *cheap;* (*b*) *effective;* i.e., capable of destroying all the spores adhering to the grain; (*c*) capable of preventing *reinfection* of the seed; (*d*) without effect on the *germination* of the grain.

Formalin and bluestone have hitherto been almost exclusively used in Victoria. Recently, powdered dry copper carbonate has been tested on the experiment farms, and it has given decidedly satisfactory results. Formalin and bluestone are used in the form of solutions of definite strength.

The normal strength of these solutions used in Victoria is:—Formalin—1 part of formalin mixed with 450 parts of water (1 lb. formalin to 45 gallons of water—and bluestone, 1½ per cent. (1½ lbs. dissolved in 10 gallons of water). The period of immersion of the seed is usually three minutes.

Experience and experimental trials have demonstrated that fungicidal solutions of these concentrations are strong enough to kill smut spores on the grain without unduly lowering the vitality of the seed. Provided the seed is sown on moist soil immediately after pickling the results are fairly satisfactory. If, however, there should be any considerable *delay* between the pickling and the sowing of the seed, there may be a substantial reduction in the percentage of germination. Moreover, if seed pickled by either of these methods is sown in a dry seed bed, the effect of the fungicidal solutions on the vitality of the seed becomes very pronounced.

Both these fungicides are completely effective in destroying smut spores adhering to the seed. But they differ very much in their power to prevent reinfection. Bluestone not only kills smut spores on the seed, but also protects it against reinfection. Formalin has little power to prevent reinfection. Reinfection often occurs, particularly where the smut balls are not removed from the seed.

Bluestone solutions afford considerable protection to the grain from reinfection. Formalin, however, is much less effective, mainly for the reason that it is a solution of gas in water, and that as the grain dries its fungicidal properties gradually disappear.

The depressing effect of bluestone and formalin on the germination of the seed, and the delay in the germination which frequently arises when these antiseptics are used, make the use of the solutions somewhat objectionable.

A more serious objection arises from the fact that the seed must be sown immediately, otherwise considerable losses may result from lessened vitality of the seed. When, therefore, these solutions are used pickling must not proceed far ahead of the actual seeding requirements. Hence, valuable time is lost during the busy seeding period.

If we could obtain at a reasonable cost a fungicide that would (1) kill smut spores without injury to the seed, (2) prevent reinfection of the seed, and (3) could be used some weeks ahead of seeding without lowering the germination and vigour of the grain, then we would have an almost ideal antiseptic for smut control.

Such a fungicide appears to be in sight. The use of finely-powdered copper carbonate for smut control was first suggested by the researches of Darnell Smith, of New South Wales. After considerable investigational work he concluded that copper carbonate dust applied to seed at the rate of 2 ozs. per bushel would give better results for smut control than bluestone or formalin solutions.

The copper carbonate dust does not cause material injury to the grain; it does not lower the vitality of the grain, and even if seed is treated some considerable time prior to sowing, no injurious effects are observed either on germination or the early growth of the crop. This permits the treatment of the seed during the slack season preceding the seeding, and so saves much valuable time during the busy sowing season.

As the germination is neither affected nor delayed by the use of these dry treatments, it follows that the young crop should germinate evenly and grow rapidly in the early stages. This results in a good vigorous stand of wheat which is invariably reflected in increased crop yields.

Time of Sowing and Rate of Seeding Trials, Longerenong.

There are two rather serious drawbacks to the use of this method —(1) the cost of the material, (2) the irritation caused by the copper carbonate dust.

Copper carbonate is much more expensive than bluestone, because it contains more than double the amount of copper. The saving in the cost of labour and the very superior results arising from the use of copper carbonate more than offset this disadvantage.

Considerable irritation may result if the fine dust is inhaled during the process of pickling, but this may be avoided by the operator wearing a dust mask similar to that used by workers in chemical factories where chemical dusts are manufactured, or by tying a wet handkerchief over the nose and mouth during the process of treatment.

Experiments Conducted for Controlling Bunt.

The Department of Agriculture of Victoria has conducted experiments for the past four years to compare the standard method of pickling with the new method of dry pickling with copper carbonate.

The experiments were begun in 1920. When they were commenced copper carbonate was unobtainable in commercial quantities. It was obtainable in chemically pure form only at a price that would be prohibitive for field work. Tests were therefore made to determine whether finely-powdered bluestone (copper sulphate) would behave in the same way as copper carbonate.

A sample of Federation seed was heavily and uniformly infected with bunt spores collected from bunt balls of the previous harvest. The treatments given were as follows:—

(1) Soaked in water for 3 minutes.
(2) Immersed in solution of bluestone 2 per cent. for 3 minutes.
(3) Immersed in solution of formalin 1 in 400 for 3 minutes.
(4) Treated with powdered copper carbonate 2 ozs. per bushel.
(5) Treated with powdered copper sulphate 2 ozs. per bushel.

Two hundred seeds were sown in each plot.

The results for the four years 1920-1923 were as follow:—

Table Showing Effects of Various Fungicides for Control of Smut—Burnley, 1920-1923.

Treatment.	Percentage of Plants reaching maturity.	Percentage of bunted Plants.	Average yield per plot.
	%	%	grams.
Untreated	69.6	70.8	311
Copper Sulphate, 1½ per cent.	58.6	2.5	950
Formalin, 1 in 450	51.4	11.1	852
Copper Carbonate Dust, 2 ozs. per bushel ..	75.4	4.9	1,251
Copper Sulphate Dust, 2 ozs. per bushel ..	65.0	2.5	1,196

For the four-year period the best results were obtained from powdered copper carbonate. This showed the highest percentage of plants reaching maturity, and gave the highest average yield per plot. The copper

sulphate dust showed 10 per cent. lower germination than copper carbonate, but a higher percentage of clean plants. The yield per plot was slightly lower than that treated with copper carbonate dust.

Both fungicidal dusts were superior to the standard pickling solutions in regard to the percentage of plants that reached maturity, and the yield per plot. When sowing was delayed for fourteen days the superiority of the fungicidal dusts was very marked.

This is clearly shown in the following table:—

Table—Effect of Various Fungicides on Germination of Seed when Sown—(*a*) Immediately after Treatment, (*b*) after 14 Days—Burnley, 1923.

Treatment.	Percentage of Plants reaching maturity.	Percentage of Plants bunted that reached maturity.	Yield per plot.
	%	%	grams.
I.—*Infected and Treated Seed Sown Immediately.*			
Soaked in water	81	68·0	508
Bluestone, 1½ per cent.	80	3·1	1,218
Formalin, 1 in 450	70	12·9	1,008
Copper Carbonate, 2 ozs. per bushel ..	88	6·2	1,427
Copper Sulphate, 2 ozs. per bushel ..	72	7·0	1,232
II.—*Infected and Treated Seed Sown* 14 *Days after Treatment.*			
Soaked in water	79	91·1	116
Bluestone, 1½ per cent.	53	7·6	840
Formalin, 1 in 450	41	39·0	530
Copper Carbonate, 2 ozs. per bushel ..	87	9·8	1,218
Copper Sulphate, 2 ozs. per bushel ..	88	9·6	1,204
III.—*Seed Reinfected and Sown* 14 *Days after Treatment.*			
Soaked in water	77	81·8	216
Bluestone, 1½ per cent.	56	9·8	820
Formalin, 1 in 450	28	60·8	197
Copper Carbonate, 2 ozs. per bushel ..	85	10·0	1,176
Copper Sulphate, 2 ozs. per bushel ..	77	8·0	1,081

These results show very clearly the value of the fungicidal dusts, especially where the sowing is delayed. The percentage of plants reaching maturity and the yield per plot is in every case highest where the seed is treated with copper carbonate.

Powdered copper sulphate is nearly as effective as copper carbonate, and is superior to the same fungicide in the form of a 2 per cent. solution where sowing is delayed.

Method of Using Fungicidal Dusts.

The application of the fungicidal dusts may be made in various ways. Special machines have been invented for the purpose of applying the dust, but in the absence of these the powder may be applied by

emptying a number of bags of wheat on a concrete floor and sprinkling the requisite quantity of powdered copper carbonate or copper sulphate upon the heap and then shovelling the heap of grain over several times until the material is thoroughly mixed. This method does not, however, give the most uniform distribution, and the fine particles of dust cause irritation to the worker.

The first machine used for pickling wheat was the Ross-Martin machine, designed by Mr. H. Ross, Inspector of Agriculture, New South Wales.

Quantity of Fungicidal Dust Required for Pickling.

The amount of copper carbonate dust recommended by Dr. Darnell Smith is 2 oz. per bushel. Two ounces of copper carbonate finely ground will effectively cover a bushel of seed. Heavier dressings have been used in America without any apparent injury to the grain. Probably lighter applications would be quite effective for seed with only a light infection of smut. The question of the rate of application of the fungicide is a matter if importance in view of the relatively high cost of the material. We know that 2 oz. per bushel is adequate for smut control even with heavily bunted seed. What is the minimum quantity of powdered copper carbonate dust that would prove effective for smut control? This is a matter worthy of investigation, for if lesser quantities of the dust will be effective one drawback to the extensive use of the copper carbonate will be removed.

Powdered copper carbonate is likely to be extensively used for treatment of smut in Victoria. The results already obtained, both in the field and on departmental farms, have been highly satisfactory.

After Treatment of Wheat.

Very frequently the crop requires some kind of attention after sowing, and the treatment will vary considerably with the growth made, the character of the season, and the nature and preliminary treatment of the seed bed.

Rolling the crop after it has grown some 6 or 8 inches is frequently practised.

With hay or ensilage crops this is often beneficial, as it helps to make a level surface for the binder, thus facilitating the harvesting of the crop. Moreover, on light, open land, the consolidation of the soil effected by rolling is very beneficial to the growing crop. Rolling may also be practised where the operations, preparatory to seeding, have not been of such a character as to provide for that soil consolidation so essential to the success of a wheat crop. On heavy lands which tend to set hard, and which are likely to run together with the winter rains, the roller should be displaced by the harrows.

Harrowing is beneficial to a young wheat crop, provided it be not already too thin. Certainly, a percentage of the young plants is dragged out in the operation, but it is well in this connexion to remember the healthy proverb, "The man who harrows should never look behind."

This disadvantage is more than compensated for by the increased vigour of the remaining plants, and by the great stimulus given to stooling; nor must it be forgotten that the harrows assist in subjugating the weeds, and in the drier portions of the State assist in conserving the limited supplies of soil moisture by retarding capillary activity and lessening evaporation.

In harrowing the growing crop the work should be done at right angles to the drills.

Feeding Down the Crop.—It has already been remarked that, in favorable seasons, the early-sown crops are likely to come away very rapidly and make heavy, vigorous, rank growth in May and June. Such heavy growth is exposed to two dangers:—

1. Lodging in wet weather.
2. Blighting either from late spring frosts, or by a premature burst of hot weather in spring.

Such growth may be arrested by feeding down with sheep. This is a decided advantage on light land, or on land which has, for various reasons, not been consolidated sufficiently by adequate tillage operations; but on heavy land it may be a positive disadvantage to feed down a crop with sheep. This would happen if the land were wet, and more or less boggy; in these circumstances the sheep would do more harm than good. In any case, unless the feeding be done fairly rapidly, little benefit will accrue from the process.

In dealing with large paddocks, difficulty arises in putting on a sufficient number of sheep to carry out the work in reasonable time. Complications arise where the crop is not uniform, and where the rank portions occur in patches. In such circumstances it becomes necessary to "shepherd" the flock, as, if left to themselves, the sheep will invariably graze those portions which do not require feeding off.

One point must not be overlooked in this connexion, and that is the time such operations may, with safety, be performed. Late feeding-down is generally decidedly detrimental, and can only be performed with any prospect of success when the spring rains are frequent and copious.

In the drier portions of the State, it is a good maxim for the wheat-grower, at all times, to plan his work with the expectation of the present season being a dry one, and, in the event of such expectation being realized, crops requiring to be fed-off will give best results when fed early. In addition to checking the rank growth, judicious feeding-off assists the stooling propensities of the plant, and reduces the proportion of flag and straw to grain, thereby avoiding the danger of blighting by hot, spring winds.

HARVESTING.

To the wheat-grower there is always a great deal of risk involved in raising the crop, from the time of seeding until the wheat is harvested. The crop is subject to many risks, any one of which may cause partial or complete crop failure. Extremes of heat or cold, drought, super-abundance of rainfall, destructive hail or wind storms, floods, fire, fungoid diseases, e.g., rust, smut, and take-all.

The risk involved reaches its maximum at harvest time. When once the wheat is ripe it should be promptly harvested. If this be not done, the period of risk is prolonged, and losses are almost inevitable. The grain may be shelled or lodged by winds or hail, or rain may cause it to lose colour or to sprout.

Though the climatic conditions in the wheat belt of Australia are more settled during harvest than in most wheat-growing countries, the farmer should always endeavour to harvest his crop with the utmost celerity to avoid the many risks outlined above.

The wheat-grower here has a great advantage over the wheat-growers of most other countries. The weather is normally hot and dry thorughout the period of harvesting. It is therefore possible to use the labour-saving harvester to garner the grain from the standing crop. This gives the Australian wheat-grower an economic advantage which enables him, though far distant from the world's wheat-markets, to compete favorably with the growers in Canada, America, and Europe. The labour-saving combined-harvester, which is the culmination of modern discoveries and inventions pertaining to harvest machinery, can only be effectively used in a hot, dry climate, where there is little danger of rain during harvest, and where heavy dews at this time are infrequent.

In the United States the use of the combined-harvester is restricted by climatic conditions to the Pacific Coast. The great bulk of the American wheat crop, and practically the whole of the Canadian harvest, has to be gathered by means of the binder and thresher—a

Harvesting Permanent Rotation Tests, Rutherglen Experiment Farm.

very costly and labour-consuming method of harvesting. The straw has very little value, except in the neighbourhood of large cities. The average cost of harvesting with binder and thresher is probably three times that of harvesting with the complete harvester or the stripper and winnower.

Australia's distance from the London market is partly offset by the comparatively short rail haulage to the seaboard. Though America is so much nearer the London market, much of the wheat of Canada and the United States has to be hauled by rail from 500 to 1,000 miles to the elevators at the Great Lakes. To bring Australian wheat from the farm to the world's markets a short rail haulage and a long ocean transport are necessary, and ocean transport is relatively cheap compared with rail transport.

Development of Harvesting Machinery.

The development of agricultural machinery is an important factor in the world's economic progress. Progress has been more rapid in the

development of harvesting machinery than any other form of implements. Less than a century ago it took a man three hours to cut with sickle and thresh with flail 1 bushel of wheat. With the modern harvester a bushel of wheat can be reaped in less than three minutes.

The ancient Egyptians and Greeks used crudely constructed sickles for harvesting wheat. Sickles are still used in the East and in parts of Russia for harvesting.

The modern stripper has its prototype in the Gallic header described by Pliny in A.D. 70. This header consisted of a two-wheeled cart pushed through the crop by an animal yoked behind the cart. The heads were stripped off the standing crop by a series of lance-shaped knives, and the ears were raked into the body of the cart as it proceeded through the crop.

Ridley, of South Australia, produced in 1845 the first successful stripper. He employed the principle of the Gallic machine, and removed the heads from the standing crop by means of a comb and a rapidly-revolving beater.

The harvester evolved next by an easy process from the stripper. It carried a winnower and performed the stripping and winnowing of the grain in one operation, delivering the cleaned grain into a large box.

The modern harvester is a most efficient, economical and labour-saving machine, and its introduction has greatly reduced the cost and labour in the harvest field, and has greatly extended the area that is possible for one man alone to deal with. Australia is one of the few countries where this implement can be used to advantage. The low cost of harvesting in Australia, the level nature of the wheat country, the labour-saving teams that are used both for tillage and for harvest, the winter distribution of the rainfall, and the hot, dry harvesting period enable wheat to be produced in Australia as economically and efficiently as in any country in the world.

The reaper-thresher is a development of the complete harvester This combines in one machine the essential parts of a binder, thresher and winnower. The ears are severed from the standing crop by a knife blade working in a manner similar to that of a mower. The ears are conveyed to a rapidly-revolving drum, which threshes the grain. The threshed grain is then conveyed by elevators to the grain box. The draught is said to be less than that of the ordinary harvester, with the same width of cut.

The modern binder was a natural evolution from the mowing machines first used in the early part of the nineteenth century. In the modern type of binder a reciprocating rectilinear motion of a knife bar fitted with sharp blades is used to cut the grain.

Salmon in 1808 first utilized the reciprocating cutter combined with the advancing motion of the machine, and also was the first to introduce a self-delivering apparatus for the grain. McCormack patented a machine in 1834. It was drawn by one horse, and possessed in crude form all the essentials of a modern reaper. Hoffhein invented the revolving vane (1852). The cutting and delivering of the grain was only a part of the harvesting problem, and many attempts were made to dispense with the laborious task of binding the sheaves by hand. Heath, of Ohio, in 1850 was the first to attempt the binding of grain by machinery, and in rapid succession a large number of patents were taken out for conveyors, knotters, automatic trips. Appleby was the first to combine these inventions with some of his own in such a way as to make a commercially valuable binder.

The modern binder has the cutter of the mowing-machine combined with a reel and travelling canvases to convey the cut grain to the automatic device for binding it in sheaves, and a sheaf carrier for collecting the sheaves in piles. The reel can be adjusted at will while the machine is in motion. The cut grain is conveyed by an endless canvas on the platform to two similar canvases between which the grain is elevated to the binding device.

As the size of the bundle increases, the resulting pressure trips the binder, which binds automatically as often as it is tripped. The pressure required for this, and consequently the size of the bundle, can be regulated. One man with three horses can bind about 12 acres a day with a 6-ft. binder, and it requires two men to stook the sheaves.

Time to Harvest.

If the crop be situated in the wheat belt proper, it is harvested with the stripper and winnower, the harvester, or the reaper thresher. The crop must be left until it is quite ripe; the grain can then be comparatively easily separated from the chaff. If, however, the wheat is grown in the more humid areas, the grain is rarely hard and dry enough to be taken off with a harvester, in which case the crop is cut with a binder and threshed. It may be cut when the straw under the ears has turned yellow. At this stage the grain is set and may be safely cut. It will fill out and improve in the stook. The crop may usually be cut at least a week to ten days earlier than it would be ready to strip. Harvesting with binder and thresher may be desirable in those cases where straw has considerable value, e.g., Werribee Plains.

Notes on Harvest Operations.

1. *Harvesting with Binder and Thresher.*—As a 6-ft. binder will harvest on an average about 12 acres a day, an area of 200 to 250 acres of wheat, which is the average crop for a wheat-grower, will require three to four weeks for one machine. A rough estimate of the probable quantity of binder twine required may be obtained by estimating one ball (4½ lbs.) for every 2 tons of hay of average length or its equivalent in grain sheaves, or if the straw is very long, 2½ tons per ball.

In the drier districts, where fine weather usually prevails, the crop is immediately stooked with twelve to fifteen sheaves in a round stock to withstand wind only. In districts liable to heavy summer rain, considerable skill is required in building stooks to shed rain, to dry quickly after being wetted, and to withstand wind. More care is required in handling grain sheaves than hay sheaves, as grain is liable to shell out by stooking in the hotter periods of the day. If the thresher be used, the most economical procedure is to thresh from the stook. This is, however, not always possible, especially where the harvesting is carried out by itinerant threshers, when it must be done in rotation; months might then elapse before the thresher would be available. This risk of keeping the grain in a stook is considerable, as rainy weather will cause sprouting, bleaching and general deterioration of the grain and the straw.

Hence, unless the threshers are available within a reasonable period, the grain should be stacked before threshing. The output of the threshers varies considerably; the capacity of the ordinary threshers ranges from 250 to 300 bags per day of ten hours.

The threshing is usually done by contract with travelling plants. When the price of straw is payable, it is best to bale it as it comes from the elevator; otherwise it may be stacked loose in large stacks and kept for future requirements.

Cavings and chaff should be saved and removed, either by a horse-rake or by catching them on a tarpaulin, with hooks attached, and dragging to a heap or to a shed, where they may be covered for use in time of need. The cocky chaff from the stripper has often served the Mallee farmer in drought years as a fodder reserve. Many farmers stack the chaff in sheds, the sides of which are covered with wire netting.

2. *Harvesting with Stripper and Winnower.*—Over the greater portion of the wheat areas the conditions are favorable for harvesting with the stripper, the harvester, or the reaper-thresher. The harvester and reaper-thresher are now generally used in the heavier flat country of the Wimmera, Goulburn Valley, and Northern areas. In the lighter Mallee country, where the ground is very rough with stumps, and the land is of a light sandy nature, the stripper is preferred to the harvester and reaper thresher. The draught of the stripper is, of course, much lighter, and there is less danger of accidents and breakages in stumpy country than with the heavier and more complicated harvester. On the light sandy country there are not so many bearings likely to wear through becoming gritty.

Harvesting with the stripper entails the use of some method of winnowing and extra labour. Damp weather machines, i.e., machines fitted with a peg-drum which deals with any heads that have not been threshed properly by the beaters, enables a fairly early start to be made in the morning, and later in the day when the wheat is threshing easily the peg-drum can be thrown out of gear, as the beaters should then be doing the work thoroughly.

It is a good plan during hay cutting to cut the wheat crop into sections suitable for stripping. If this has not been done it is economical to do it with the stripper. The corners should be kept square by going straight out at the corner and bringing the team round to the near side and striking the crop with a full comb.

As few heaps of chaff and grain should be made as possible, but at the same time one should not sacrifice too much time in travelling to achieve this.

Winnowing may be done by hand or by a motor winnower. In either case it should be worked at even speed, placed so that the wind blows from the fan and away from the machine, and the sieves and tail-board should be set so as to allow all chaff and cavings to blow over without loss of grain or wheaty heads.

3. *Harvesting with Harvester or Reaper Thresher.*—These machines combine the work of the stripper and winnower. They are both efficient and economical machines, and their introduction has lowered the cost of harvesting and the amount of labour required for harvest. In using the harvester no more straw should be taken than is necessary to secure all the wheat, or the sieves will tend to get blocked. In order to make a good sample, the sieves, beaters and peg-drum must be carefully adjusted, and the team driven at a uniform speed. The grain box usually holds 2½ to 3 bags; it should be emptied at regular intervals, and the bags sewn at once.

The reaper-thresher is a combination of mover, thresher and winnower. It is very light in draught in comparison with the cut it takes. It is particularly useful for garnering tangled crops.

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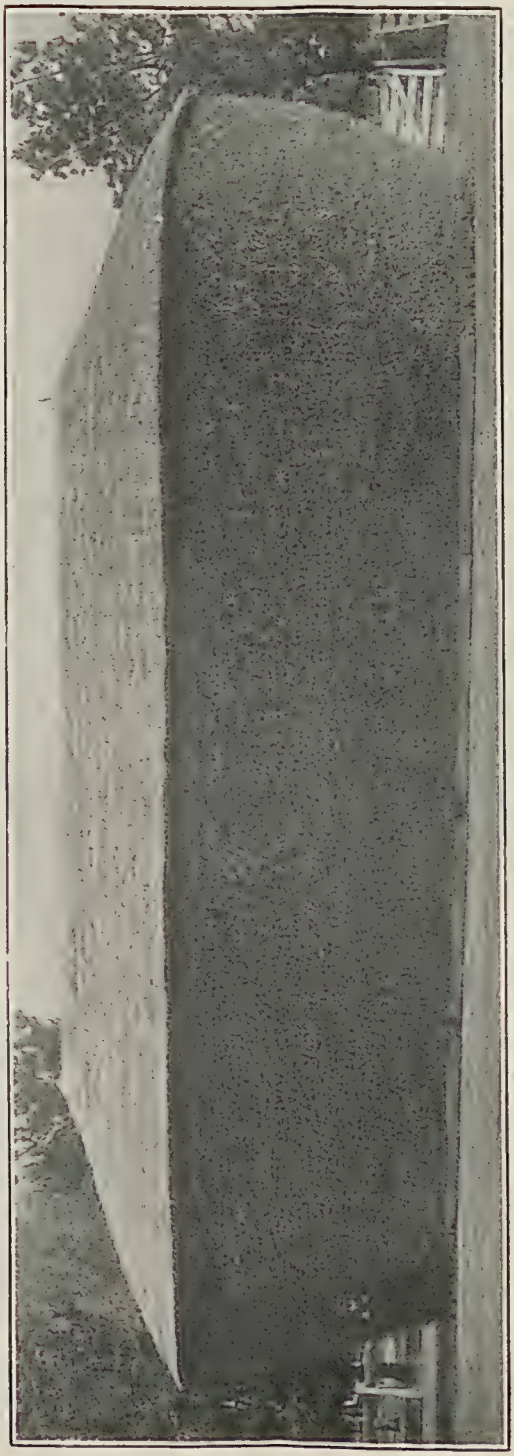

A Well-built Haystack.

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In consequence of the efficiency of the threshing-drum and its non-liability to choke, a crop can be taken off in damper or cooler weather than with either the stripper or the harvester.

Harvesting Wheat for Hay.

The hay crop forms an important part of the harvest on every farm. In Victoria the area of oaten hay greatly exceeds that of wheaten hay. In New South Wales, South Australia, and Western Australia the area under wheaten hay far exceeds that under oaten hay. 12½ per cent. of the entire wheat crop of Australia is annually cut for hay.

(*a*) Time of Cutting.

The nutritive value of cereal hay depends on the period of growth at which it is cut, both for the resultant digestibility and the portion of the plant in which the nutrients are to be found. The object is to cut hay at the period of growth when (1) the nutrients are spread most evenly throughout the plant, (2) the hay will be most digestible to stock, and when (3) the plant has elaborated most of its dry matter.

Some interesting investigations were carried out by Professor Perkins at the Roseworthy Agricultural College as to the best stage at which to cut wheaten hay. His conclusions were as follows:—

(1) The highest quality hay is secured when the grain is full size, but in the milky stage. If the hay be cut at this stage, ears, culms, flag will all prove equally nutritious, and if carefully cured will show a bright green colour, and a small quantity of shrivelled grain.

(2) The heaviest yields are obtained when the grain has fully reached the dough stage. Hay secured then will dry and bleach, and carry a large proportion of grain. It will probably be more or less indigestible, and will not be the equal as a foodstuff of hay cut at earlier stages.

(3) The usual commercial standards for quality in wheaten hay—colour and shrivelled grain—are amply justified.

(*b*) Varieties to Sow.

The choice of suitable varieties for hay is determined by the following points:—

(1) Vigorous growth and stooling capacity.
(2) Abundant foliage and beardless chaff.
(3) Sweetness and fineness of stem.

Very early wheats are generally poor stoolers, and very late wheats, although yielding heavily under favorable conditions, are likely to bring hay-cutting into harvest weather. The following varieties are suitable for hay:—Warden, Majestic, Baroota Wonder, White Tuscan, Huguenot, Firbank (for dry districts).

Often a mixture of wheat and oats is grown for hay. A mixture largely used on the Werribee Plains is Algerian oats 1¼ bush., Warden wheat ½ bush.

(*c*) Curing the Crop.

The binder is almost exclusively used for cutting hay. In cutting the crop the sheaves should be tied at such a height that they will be

evenly balanced. This can be done by suitably adjusting the distance of the knotter from the butter board. The sheaves should be laid in regular rows and stooked as soon as possible, so that they may not be exposed to sudden drying influences too long before being stooked. The quality of the hay is lowered by exposure to rain, mainly through leaching of soluble nutrients by the rain and the loss of volatile compounds by exposure to sun. Large round stooks dry more slowly, and so give a smaller percentage of bleached sheaves than long open stooks. The former are more suited for dry districts, while the latter are better for humid localities.

Should heavy rain occur during this period, the stooks should be taken to pieces and made into smaller ones to facilitate drying. In this case, as soon as the hay is dry, it should be carted, as if left in small stooks it will deteriorate.

(*d*) Stacking.

The sheaves are allowed to remain in the stooks until they are sufficiently dry to stack, i.e., until they have reached the stage when they will not heat or mould when stacked. The hay should not be left any longer in the stook than is necessary to cure it. If on inspection of a handful of straws drawn out from the centre of a stook the nodes are dry the hay may be stacked without danger.

Mice cause much damage to hay, especially when it has been stacked for some years. To save losses from this source two methods are commonly adopted: (1) to build the stack on a stage resting on piles covered with galvanized iron. Stages may be erected on piles 6 inches in diameter, 3 feet in length, and sunk 18 inches in the ground. These piles are covered with kerosene tins placed upside down, or with galvanized iron. The floor is built on joists fastened to the piles. (2) The stack is built on the ground or on dunnage, and a fence of plain galvanized sheet iron sunk to 6 inches in the soil is erected completely round it.

Compared with small stacks, large stacks have less waste, and a smaller face exposed. Stacks of 100 tons are convenient in size to build. A stack 66 feet x 22 feet will usually hold about 100 tons, if the height to the eaves is 12 feet to 15 feet when first erected.

The best method of building a stack is to begin from the outside, working always to the centre, with the butts outwards, and keeping the surface with a crown to the centre to give pitch for any water that may penetrate the roof of the stack. When it is decided to put on the top, the last row of sheaves is projected 3 to 6 inches further than the previous outside row to make an eave.

In making roofing, each successive layer should be drawn in about 6 inches to 8 inches, the last sheaves being practically stooked on top, lightly packed together with heads interlocked by opening and dovetailing them with one another. The stacks should be thatched as soon as possible. This may be done by the use of thatch matting made from straw.

(*To be continued.*)

APRICOT GROWING IN VICTORIA.

(Continued from page 708, Vol. XXI.)

By W. H. Nicholls, Orchard Supervisor.

III.—Propagation.

As mentioned previously, apricot trees are easily grown from seed, and although many good types have been obtained in this way, seedlings are used generally for purposes of propagation, either by budding or grafting; both methods answer well, the wood being easy to work. Budding, however, is the most efficient and economical. In order to make the description of this operation clearer, several illustrations are

Fig. 3.

A.—Incision ready for inserting bud. *B.*—Inserting bud. *C.*—Bud inserted. *D.*—Bud bound.

reproduced from an article on the Propagation of Fruit Trees, written by Mr. C. F. Cole, Orchard Supervisor, which appeared in this *Journal* some years ago.

It is necessary to emphasize the importance of stock and bud selection, for many instances are to be found where trees are non-reproductive because of either faulty parent or weak stocks.

Only the strong and vigorous seedlings should be used. Trees grown from weaklings may display sickly tendencies throughout their whole life. For the same reason, one must be even more particular in the selection of the trees from which the scion or budding wood is taken; if uniformity in type and bearing quality is to be attained trees having

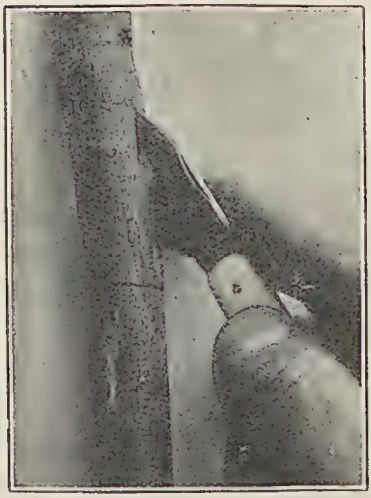

Fig. 4.—Position to Ensure a Straight Vertical Cut.

Fig. 5.—Opening Bark to Receive Prepared Bud.

Fig. 6.—Cutting a Bud.

Fig. 7.—Cutting off Stock.
(Dotted line shows where cut should be made.)

these characteristics must be chosen; indeed, one should go further and select only such limbs or even branches as show a predisposition to these requirements.

Fig. 3A illustrates the stock with the T-shaped cut slightly opened ready to receive the bud; 3B is the bud being inserted; 3C the bud in position; and 3D the bud bound with raffia.

Fig. 4 illustrates how the vertical cut is made in the stock; Fig. 5 the bark being lifted to enable the bud to be inserted, and Fig. 6 the method of taking the bud. The dotted line in Fig. 7 shows where the cut should be made when the bud has started.

Care is essential if good results from budding are to be obtained. Stocks that are active and in which the sap is flowing freely must be selected. Budding must never be attempted in extreme heat. The budding wood should be freshly cut, and only matured and prominent buds used. Fitting and tying in should be as exact as possible so as to ensure the meeting of the bark at the T cut, the descending sap being the factor that causes "callusing" to take place. When budding is done in the spring, the stocks may be cut (as shown in Fig. 7) as soon as the bud has started; but with autumn—or dormant—budded stocks, the orchardist must make certain that the stocks are *active*, and that the sap is being drawn *past* the bud, which when the descending sap reaches it commences to grow. Not until then should the stock be cut as shown in Fig. 7.

In order to obtain symmetrical trees, it is necessary to stake the buds. Cuttings of some other trees about 18 inches long are sometimes used for this purpose, and as the buds grow they are tied two or three times. When they have attained a height of 18 inches they may be "headed" at a height of 15 inches. But care must be taken to ensure that the buds are mature, so that a uniform growth will ensue, thus giving a nicely-balanced crown, which as time goes on will become the starting point of the permanent frame-work necessary to build up trees capable of supporting a crop, and still maintaining the uniform shape that is so desirable.

Grafting is done in spring, and under certain conditions is recommended. For instance, an orchardist may have some young trees of a variety not suited for his requirements; by top-grafting these he is enabled to retain the strong stems while replacing the "heads" in one season that have been removed. Such an advantage could not be gained if the same trees were "budded." There is a proportion of seedlings, also, which owing to their erratic growth do not tend to give good results when budded; these are base-grafted in spring, and by retaining one growth only, the result is as satisfactory as that which could be obtained by budding on the better stocks.

Grafting is done by uniting the scion and stock, which operation is quite simple if sufficient care be taken to make a clean and neat union. There are several methods of grafting, such as the saddle, side, cleft, and whip. For ordinary stock purposes the latter is generally practised.

The scions should be cut from the parent trees in the winter and "heeled in" until required; this retards the activity of the buds, and allows the scions to be "worked on" in a dormant condition.

When the time for grafting arrives, the end of the scion should be cut off with a sharp knife. This operation must be done cleanly with one straight angular cut, commencing three-quarters of an inch from the base. The stock is cut in exactly the same way, and both scion and stock are then " tongued " about mid-way along the cut as illustrated in Fig. 8A. The operator is warned to be careful to see that the cambium layers of stock and scion meet. Fig. 8B shows scion and stock united. Fig. 8C shows the grafted stock bound with grafting cloth.

Older trees to be worked over should be cut down in winter to within about 12 or 15 inches of the crown. In the following autumn the young growths are fit for budding, and a good plan is to place the buds always

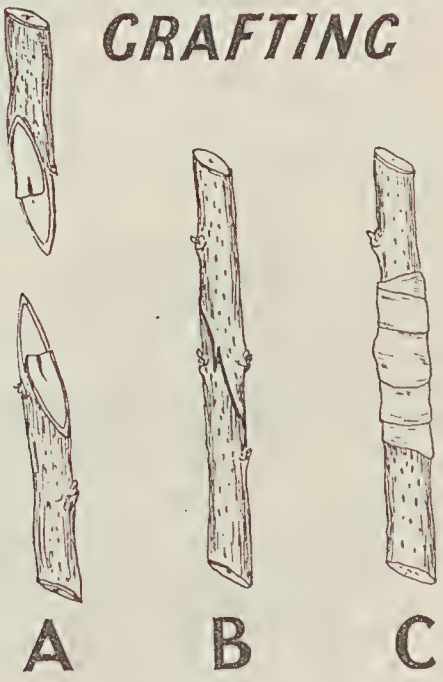

Fig. 8.

in such a position that the subsequent growths will be " into " the wind. When the buds have made, say, six inches of growth they should be stopped by " pinching out " the tip; this causes the bud to thicken and double at the base, thus giving a much stronger union.

Once the buds are well under way the surplus growth above can be removed.

IV.—Varieties.

Growers have been greatly assisted of late in the choice of varieties for canning purposes by the statements made by canners and other authorities, who have practically decided in favour of only four varieties, viz., Shipley, Tilton, Trevatt, and Rose d'Vacluse, and have totally dispensed with Moorpark.

A list of varieties in their order of ripening is given:—

Variety.	Time of Ripening.			Remarks.
Newcastle	November 21	to	November 23	Dessert
St. Ambrose	„ 26	„	„ 29	Canning
Oullins'	„ 30	„	December 6	Dessert
Hemskirke	December 9	„	„ 14	Dessert
Kaisha	„ 15	„	„ 17	Dessert
Moorpark	„ 16	„	„ 19	Dessert and drying
Shipley (Blenheim) ..	„ 19	„	„ 21	Canning
Campbellfield's ..	„ 19	„	„ 21	Dessert and drying
Tilton	„ 24	„	„ 28	Canning and drying
Mansfield	„ 25	„	„ 29	Dessert
Trevatts'	„ 25	„	„ 29	Canning
Alsace	January 2	„	January 4	Dessert and drying
Rose de Vacluse ..	„ 2	„	„ 4	Canning

Other varieties grown include:—

Royal	Large, good for drying.
Harris	Large, early, good quality.
Gooley	Large, early, good quality.
River's Red ..	Mid-season, good quality.
Early Moorpark	Similar to, but earlier than, Moorpark.
Dundonald ..	Large, dessert, late.
Harris	Large, dessert, early.
Smith's Triumph	Large, good colour and bearer, dessert, mid-season.
Montgamet ..	Medium, dessert, early.
Beauge	Medium, dessert, mid-season.
Emulator ..	Large, dessert, rich flavour, mid-season.

A perusal of the above list shows that the whole period from the earliest to the latest variety is but five weeks, and unfortunately the varieties most sought after ripen in a period of about ten or twelve days. Growers are therefore advised to plant only those varieties which are best suited for the requirements of the present day, and to allow for as much time as possible between the ripening of the fruit of the varieties chosen.

V.—Situations.

There is but little choice in the northern irrigation areas for the site for apricot trees, most of the sites being open and exposed, and on flat country. As apricots are among the first fruits to come in, the arrangement of the orchard should be such that the block of early fruits will be accessible at any irrigation period without there being any need to traverse sodden ground to gather the crop. The trees must be planted well away from channels, otherwise damage to the trees will inevitably result from root-rot. In the southern areas a northerly and easterly aspect will be found most suitable. Advantage should always be taken of undulating ground, with shelter present on the south and south-east.

(To be continued.)

THE PRODUCTION AND FLUE-CURING OF TOBACCO.

(Continued from page 443.)

By G. E. Marks, Assistant Tobacco Expert.

Fertilizers.

Tobacco uses potash, nitrogen, and calcium in larger quantities than most other plants. Analyses show that a crop of 1,000 lb. of crop tobacco will remove from the soil about 80 lb. of potash, 60 lb. of nitrogen, 40 lb. of lime, and 16 lb. of phosphoric acid. The quality depends largely upon the kind and quantity of fertilizers used. In addition to the fact that large amounts of plant foods are used by tobacco, the best qualities of leaf are grown only on naturally poor, sandy soil, such soil being free from excessive injurious food material, but must be supplied with sufficient of the different elements of food to keep the crop rapidly growing from the time the seed is sown until the plants are harvested.

Soil and climate influence the character of tobacco, and upon these will depend the kind or type of tobacco grown. The grade or quality of any type depends, chiefly, upon the method of cultivation and curing, as well as the kind of fertilizers used. Where the cultivator is used freely, the grade and quality are improved. As the quality is more essential than yield, certain plant food compounds must be avoided. For instance, tobacco grown on land containing an excess of common salt (sodium chloride) possesses bad burning qualities.

Potassium should not be applied, therefore, in the form of chloride (either muriate of potash or kainit), but as a sulphate or carbonate. Chlorine or excessive nitrogenous fertilizers impair the smoking quality of tobacco. These elements are chiefly responsible for the bad aroma of tobacco grown on dark river flats. Too large applications of nitrogen in any form tend to produce a thick, coarse, gummy leaf, with large ribs and veins, unsuitable for curing bright colours.

Nitrogen.

Nitrogen can be used in forms of nitrates, ammonia, or organic nitrogen as supplied by vegetable manure. Nitrate of soda is the most readily available form, while the sulphates and organic forms have to undergo certain stages of decomposition before the nitrogen is available for plant use. Hence they should be applied to the soil some considerable time ahead of the requirement of the crop; two or three weeks at least, and more in the case of organic matter.

Calcium.

Calcium, though not a plant food, is used in large quantities, and can be supplied in the form of ground or burnt limestone or gypsum. In the case of burnt limestone, it is better to slake it with just sufficient water to reduce it to a very fine powder. Too much water will render it pasty.

The first action of lime when applied to the soil is to correct acidity: it also favours decomposition of organic matter. Some noteworthy experiments have shown that in nearly every case where lime was an adjunct to the other fertilizers an increase in yield was recorded.

We draw the conclusion, therefore, that relatively smaller amounts of nitrogen, potassium, and phosphoric compounds are required where lime is present. Quicklime or freshly-slaked lime should not be used in excess on sandy soils unless there is an abundance of organic matter present in the soil. On clay soil, lime has the power of flocculating or grouping the soil particles there by improving crumb structure. It is best applied by being broadcasted and then lightly harrowed in. Where green crops are being ploughed in for humus and plant food, it is a good plan to plough in the lime at the same time, as decomposition is thereby hastened and plant food made available sooner. Lime aids the action of bacteria, which cause the general process of decomposition of organic matter in the soil, whether by decay or putrefaction. This organic matter supplies nutrition for the bacteria, which in turn transform it, by means of their secretion, into available forms of plant food.

Phosphates.

Phosphates are deficient in most of our Victorian soils, and should therefore be supplied in large quantities, superphosphate being the most convenient form to use. It is a common practice in America to apply seven or eight hundred pounds of superphosphate per acre to tobacco land. Superphosphate improves the quality and increases the proportion of yellow cigarette leaf in a crop, and promotes earlier maturity. It can be either broadcasted over the field and then harrowed in, or applied in drills. The method adopted will depend upon the quantity used. In cases small amounts are employed, it is preferable to drill in. Supherphosphates promotes root development, and should, therefore, be used in the seed-beds.

Potassium.

Tobacco being principally a potash feeder, potash should be present in abundance in the soil. Experiments have shown that where potash or either of the other two elements of plant food are lacking, the crop will be light. Potash improves the burning quality, promotes vigorous and healthy growth, and gives the leaf a fine flavour and texture. On poor, sandy soils it is found necessary to supply at least twice the amount of 80 lb. used by the crop, as the roots do not come in contact with all parts of the soil, and collect only that food within reach.

Green Crop Manures.

Green crops are grown and ploughed in for their manurial value, and for rendering physical benefit to the condition of the soil for succeeding crops. The benefits of green crop manures are many. Leguminous crops, such as beans, peas, &c., not only supply organic matter by their stems, leaves, and roots (the amount of which varies, according to the growth of the crop, usually from 1 to 2 tons of dry matter per acre), but these plants also possess the power of utilizing atmospheric nitrogen by the agency of nitrifying bacteria, thus adding to the soil supplies of this element in form available for future crops.

These nitrogen-gathering bacteria live and work in the nodules on the roots of leguminous plants, collecting nitrogen from the atmosphere, making it available for the host plants' use, and the plant in turn, when ploughed in, returns its store of this element to the soil for the use of other crops. These crops are of most value when ploughed in while in the flowering stage.

Other green crops, such as rye, oats, &c., have not this power of collecting nitrogen from the atmosphere, but must obtain their supplies from the soil. In this class of green crop no addition of nitrogen occurs, and only that plant food taken from the soil is returned to it and made available by the aid of micro-organisms in course of decomposition after ploughing in. Lime should be applied where green manures are used, as it assists decomposition and corrects acidity arising from this type of manure. Green crops should be ploughed in while in a soft and sappy state. This should be six weeks or so before planting tobacco, which gives time for rotting or decomposition to take place. Green crops supply humus, giving body to sandy soils, and rendering them more absorbent and moisture-retaining, with the result that plant food which otherwise would be lost are retained. Many tons of fertilizers are used to little account owing to lack of humus in the soil. Tobacco grown on such raw soil is hard and harsh to the touch, with little or no elasticity. Humus is the very life of the tobacco plant, as compactness of soil is overcome by its use. It is, therefore, invaluable in stiff soils.

Leguminous crops, (field peas, crimson clover, &c.) are the best for poor, sandy soils, while rye or other non-leguminous kinds are more suitable on soils which are already adequately supplied with nitrogen. Sometimes both peas and rye are sown together. In the case of rye, if the disc harrows are run over the ground a couple of times, the discs lapping so as not to make the ground uneven, an efficacious means of chopping up the crop will be found, especially, of course, if it has previously been mown down.

Crops should not be turned under too deeply, particularly on stiff soils. In all cases it is best to cultivate the land after the crop has been turned under, as this will tend to fill in any large cavities and at the same time admit air, so necessary for the use of the micro-organisms which cause the rot.

Combating Insects.

Insects that prey upon the leaves of plants, eating holes in them, can be destroyed by spraying them with a solution of Paris green or arsenate of lead, directions for the use of which are usually given on each manufacturer's preparation. Paris green spray, in the following proportion, is found effective in most cases: 1 lb. of Paris green to 150 to 300 gallons of water. Powdered arsenate of lead at the rate of 1 lb. to 75 lb. of corn meal has proved most efficacious for bud worms or caterpillars, which eat the centre bud and leaf. Apply by dropping a pinch in each bud, as it is here that the moth deposits her eggs and the young caterpillars are hatched. Sap-sucking insects are not poisoned by Paris green or arsenate of lead, as they do not eat the leaf. They must be treated by applications of tobacco, either in the form of a decoction sprayed directly upon the pests, or in the form of a powder applied with a sulphur bellows. This causes irritation and subsequent death. Tobacco decoction is made by soaking or boiling tobacco-leaf in water.

Kerosene emulsion is also effective in the destruction of sap-sucking insects; it may be applied with a spray. To facilitate effective spraying of the seed-beds two persons should co-operate, one to draw the cover back off the bed, while the other applies the spray before the insects have time to escape.

Curing Barns.

The curing barn, if not already erected, must be built while the crop is growing. It can be built of many different materials, and may be of varying dimensions. What may almost be spoken of as the standard-sized barn is 16 feet by 16 feet, and about 15 ft. 6 in. to the eaves, which is illustrated in Figs. 1, 2, and 3.

The barn should be made practically air-tight, and supplied with ample ventilators, not less than four 2 ft. 6 in. by 2 feet in the roof, and four vents 2 feet by 1 foot at floor level, each lot being evenly distributed Two of the floor vents should be placed near the hottest

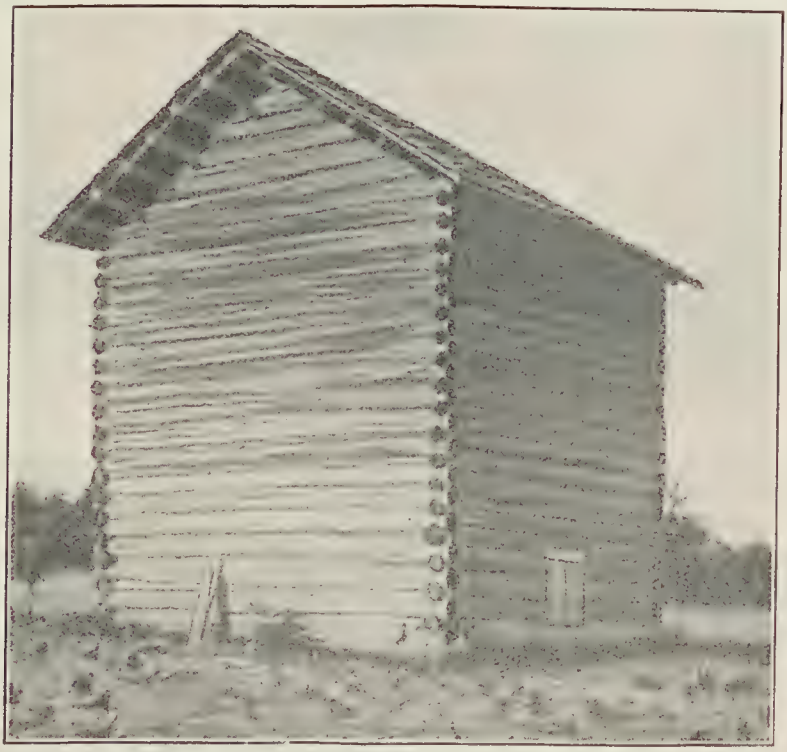

Fig. 1.—Typical Cabin Roof Barn often found in Virginia.

(Reproduced from a pamphlet, *The Production of Bright Tobacco*, by J. C. Hart, Virginia, U.S.A.)

part of the flue, while the roof vents are best placed about 3 feet from each wall at the corners. Sometimes the roof vent is placed along the ridge, and is made of a board about 12 inches wide, hinged to the ridge-pole, and overlapping the roof covering by about 3 inches, rendering it air and water-tight. A good plan is to make a V-shaped ridge capping out of two boards each, say, 9 inches by 1 inch, to conform with the two sloping sides of the roof. This ridge-cap may be provided with suitable cord or batten lifts at each end of the barn, on the outside, so that it can be lifted up or down at the curer's will. This form of vent is simple, and when open acts as a roof over the opening, which is left full length of the barn and 9 inches wide.

Fig. 2 shows the arrangement of furnaces and flues in a flue-curing barn made of logs or any other material, while Fig. 3 illustrates the arrangement of tiers. These two drawings represent the plan of an average flue-curing barn. Where a ridge ventilator is used it should run the same way as the flues (see snow barn). Figs. 4, 5, and 6 illustrate the Snow Barn, which is by far the most convenient and economical. In Fig. 4, the curing-room, it will be noted that the pair of tier beams is formed into a frame, which after being filled

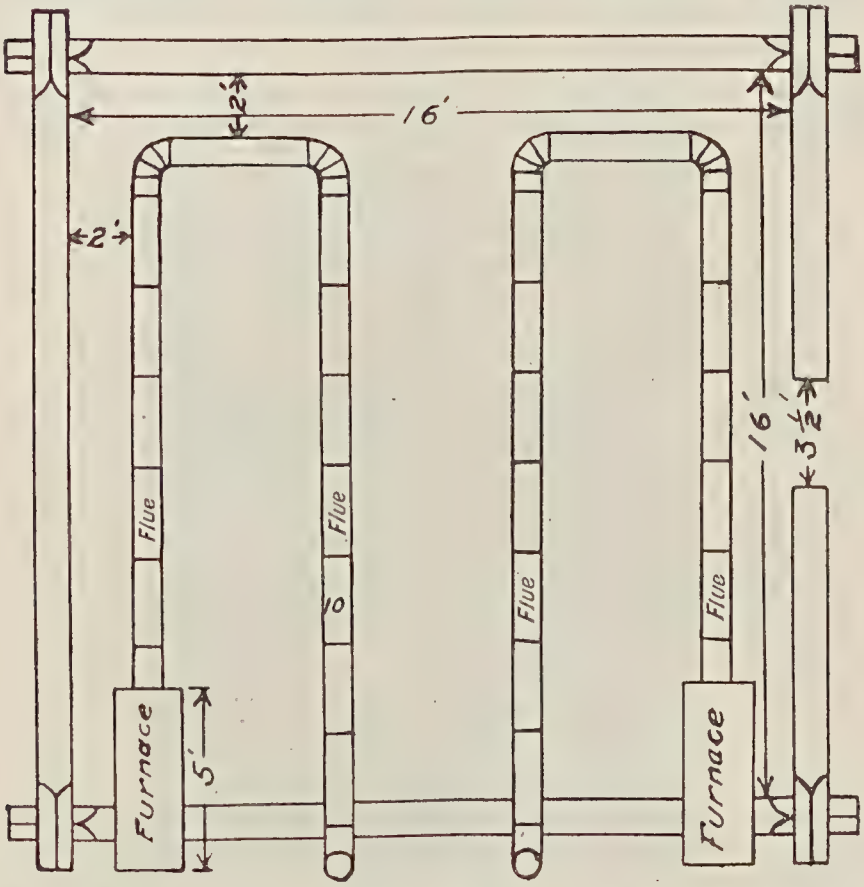

Fig. 2.—Sketch showing the Arrangement of Furnaces and Flues in a Flue-curing Barn.

with sticks of leaves is hoisted by means of rope and pulley to its position. However, if desired, these frames can easily be replaced by the ordinary fixed tier beams, as shown in Fig. 2. The beams are placed about 4 feet apart from the centre to centre, horizontally, and where it is intended to leaf-cure 2 feet above each other; while if the whole plant is to be cut and cured, as is the case in stalk-curing, it will be found necessary to place the beams about 3 ft. 3 in. apart vertically, according to the class or size of the crop it is intended to accommodate. The beams should run crosswise the entrance of the barn as shown in Fig. 4, leaving a passage-way through the centre of the room opposite the door.

It will be noticed that the snow barn is provided with a basement, in which the furnaces and flues are arranged, as shown in Fig. 6. The curing-room floor is about 5 ft. 6 in. above the floor of the basement. The floor joists are of 5 in. by 2 in., supported by bearers and piers, and are floored with 3 in. by $1\frac{1}{4}$ in. hardwood flooring, placed about $1\frac{1}{4}$ inches apart, except near the walls, which must be closely boarded for about 18 inches to obstruct the current up the walls and direct it through the tobacco. The spaces between the boards permit the hot current of air to rise up through the tobacco.

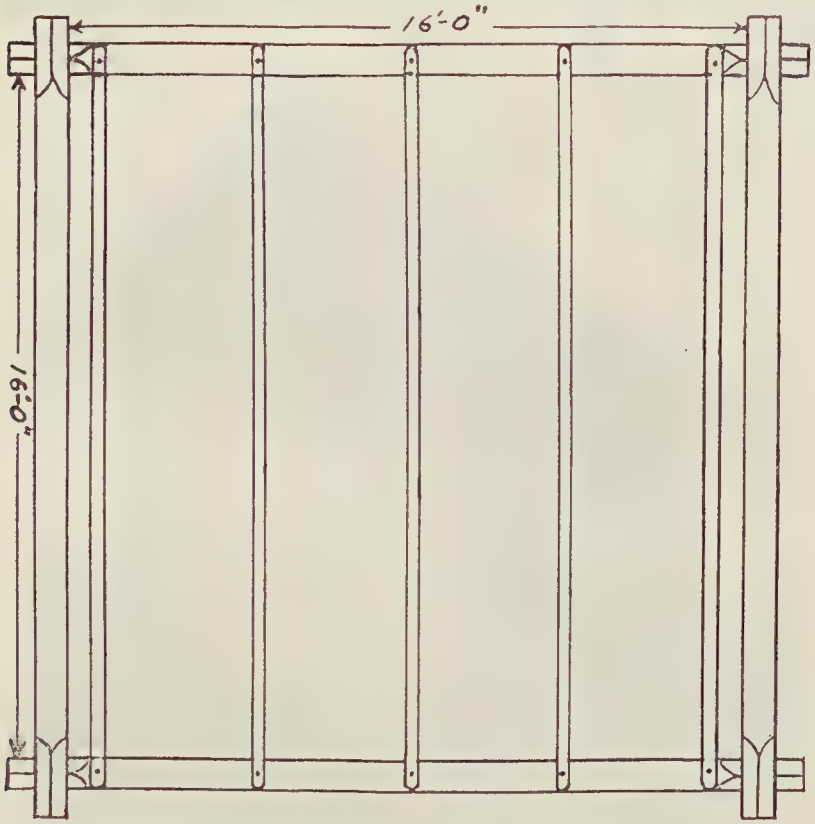

Fig. 3.—Sketch showing Arrangement of Flues in a Flue-curing Barn.

Fig. 5 gives a general view of the snow barn from the front. It will be noticed that the site upon which this type of barn is to be built is much more convenient if there is a natural fall in ground, which allows one to enter the curing-room on the high side and feed the furnaces on the low side. The inside measurements of the furnace should be 6 ft. by 1 ft. 6 in. It should be built of 9-inch brick-work, about six courses high in the walls, and provided with brick arch. A sheet of plain iron, bent to a semi-circle, and tacked to three pieces of wood, 18 inches long, will make a centre over which the brick arch may be built. This iron centre is placed in position inside the walls

and supported on some bricks. After the brick arch has been built this centre iron may be removed. The furnace should be built about half-way inside the barn.

The usual diameter of flues is 11 inches. Flues may be made of 6 ft. by 3 ft 24 gauge sheet-iron, the two edges of which are bent about a quarter of an inch in opposite directions. The two turned edges are then hooked together and hammered down in a seam. A plumber's seaming set is used for this purpose, and will ensure a neat job. The first three feet of flue joining the furnaces should be of brick or cast-iron, for the great heat produced would soon burn through thin iron. By neglecting this point many barns are burned down. No

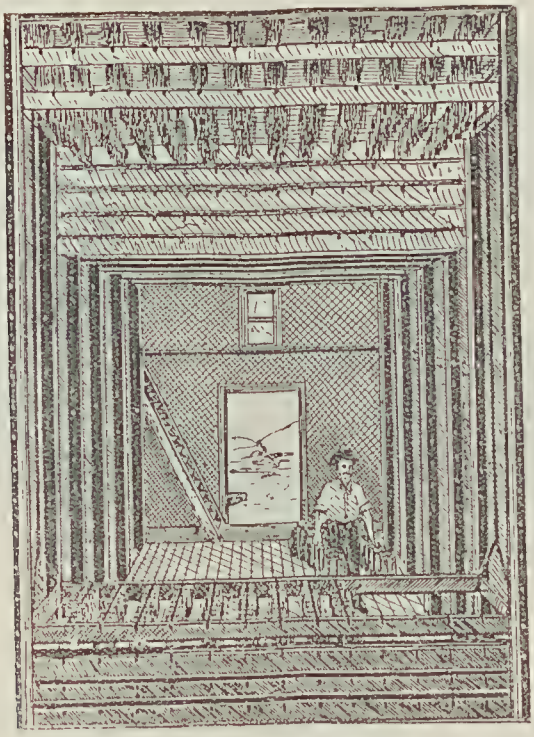

Fig. 4.—Curing Room.

timber should be near the furnaces—even posts at a distance of 2 feet will take fire at times. Sheet-iron or brick should be used in that section of wall close to the furnace, say, within 3 feet. The flues should have a gradual rise of half an inch in every foot from the furnace to the outlet.

One furnace will suffice for a barn 12 ft. by 12 ft., and may be placed in the centre of the back wall. In this case it will be necessary to have at least one flue leading from the furnace to within 2 ft. 6 in. of the opposite wall, then by inserting a tee (T) piece of flue, the flues may be run around the four walls, coming out into the chimney over the furnace.

As the work of the curing barn is to continue and finalize the life process of maturity, it is essential that the barn should be supplied with windows to admit light, as plants transpire, or give off their moisture more readily in light than in darkness. Some barns are fitted with skylight ventilators in the roof, which is an additional advantage. The arrangement of windows is shown in Fig. 5.

Frame barns may be covered with weatherboards and lined with ruberoid, malthoid, or other similar material. Cement, concrete, or brick barns, however, are the most durable. Cement slabs, about 1½ or 2 inches thick, and 4 ft. by 1 ft. 6 in. wide, with wire embedded each way to reinforce, make a very good wall. They are placed in grooves provided in the posts of the barn frame, in the same manner as the old-time slab huts.

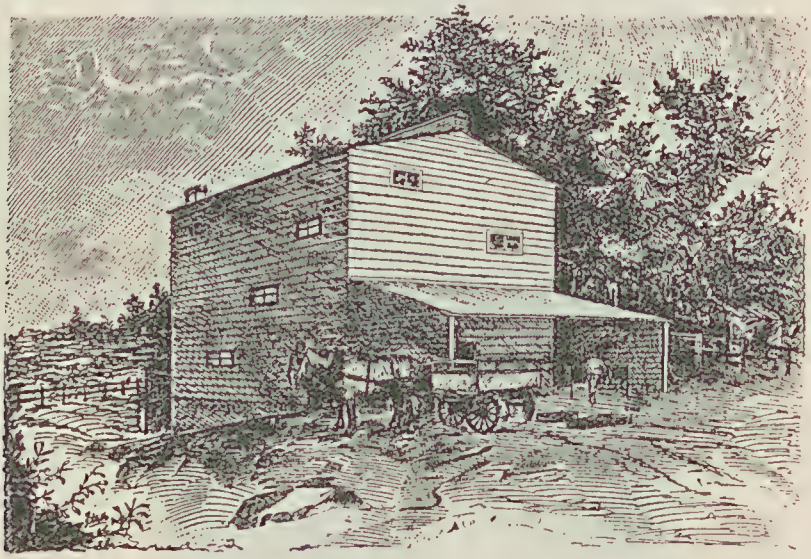

Fig. 5.—General View of "Snow" Barn.

Some barns are constructed by putting sheet-iron, or such material, on both inside and outside of studding, and then filling the cavity with saw-dust or moist soil, which should be well rammed. The roof should also be made air-tight by boarding over the outside of the rafters and then covering with ruberoid.

The arrangement of flues should be such that even distribution of heat is obtained. This can usually be effected by the addition or reduction of the brick flue in the barn, as the case may require. A loose sheet of iron hung over the hottest part of the flue will help to distribute the heat. It is a good plan always to stretch wire-netting across the barn, under the tobacco, to prevent falling leaves from reaching the hot flues.

Harvesting the Crop.

There are two general methods of harvesting, or gathering, tobacco —one in which the whole plant is cut, known as stalk-curing; and the

other, where the individual leaves are picked, known as leaf-curing. The leaf-curing, or priming method, is regarded as the more satisfactory, as a more uniform cure will result if the barn is filled with leaf of similar maturity. This is especially so in the case of the heavier types of leaf, which can be cured brighter, and which, under this method, are more easily deprived of the extra amount of sap they contain.

Shortly after the tobacco has been topped the bottom leaves will commence to ripen, which is indicated in those grown on sandy soils by a change in colour from a dark to a pale green; while in the case of those grown on heavier soils the leaves become mottled with yellow spots. If these bottom leaves were left on the plant until the top ones were ripe they would have started to decay, resulting in loss of both weight and quality. In leaf-harvesting the leaves are picked as they ripen, taking, say, the first four bottom leaves from each plant at each picking. In this way the whole of the crop will be gathered

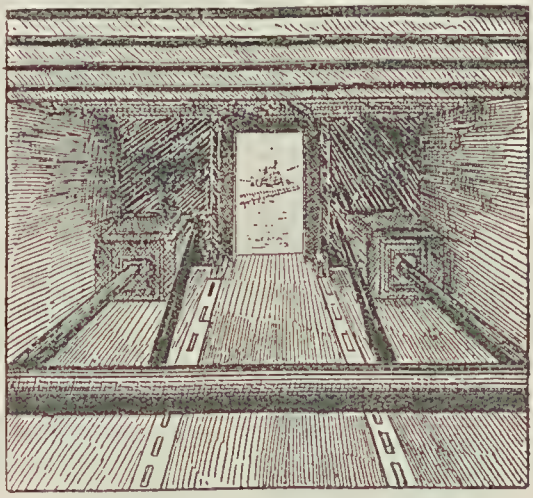

Fig. 6.—Interior of Basement.

in about three pickings. Of course there are exceptions to this rule, for the lower the plants are topped the less time will elapse between the maturing of the top and bottom leaves.

When the ripe leaves have been broken from the plants they are placed evenly in baskets, or small bundles of from 30 lb. to 50 lb., in hessian, with butts outward, and are then carted to the barn on a slide or lorry, where they are placed on sticks, as illustrated in Figures 7 and 8. The stick in Fig. 7 is known as the "snow stick," and is made of 2 in. by 1 in. hardwood, 4 ft. 6 in. long, with No. 12 gauge steel galvanized wire points, projecting about 7 inches on both sides and spaced about 6 inches apart, commencing 6 inches from the end. Thus a stick about 4 ft. 6 in. long would have about fourteen points, holding about eight leaves each. This method is generally agreed to be the best, as the leaves are kept separate and straight, which is an important factor in the curing of high-grade leaf. The sticks are next

placed in the barn, and spaced on the tier beams with their points just touching.

Fig. 8 represents the string method of hanging leaf, and is self-explanatory. The string used is of medium thickness, and is tied about four inches from the end of the stick. A bench is placed at right angles to the stand holding the stick. On this bench the bundles or baskets of leaf are placed. One or two persons hand the leaf to a third, who hitches them on to the stick in bundles or groups of two or three leaves, according to size, by wrapping the string once around the butts of the ribs of the leaves, forming a figure 8, as it passes

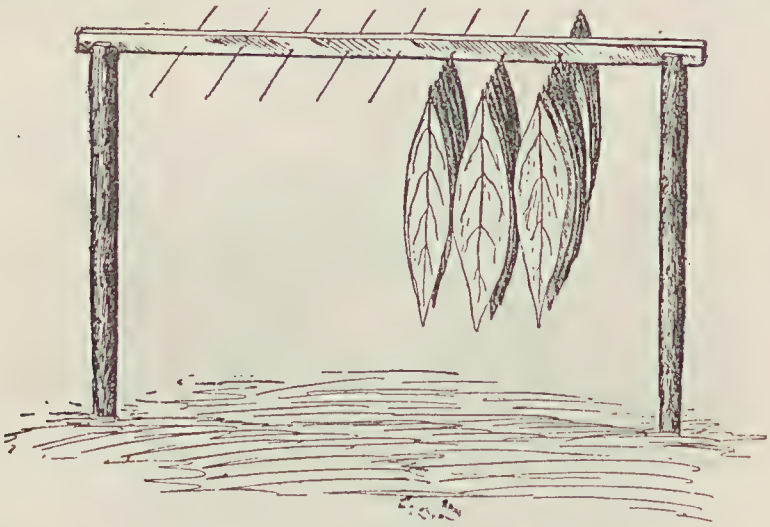

Fig. 7.—Wired Tobacco Stick—sometimes known as the "Snow" Stick.

Fig. 8.—String Method of Hanging Tobacco.

from one side of the stick to the other, as shown. The bundles or groups of leaves are spaced about two or three inches apart on the stick. Too many leaves in a group will sweat and discolour, and also retard drying. When the sticks are hung in the barn they are spaced six inches apart.

Though this method is inferior to the employment of the wire stick, it still has some points to commend it, as it is faster, and, consequently cheaper, especially in the case of small leaf.

Stalk-curing is a method by which the plants are split down the centre from the top to within three or four inches of the bottom leaf, and then chopped off below the bottom leaf three or four inches below the slit. The plant is then straddled across the stick or pole. About six or eight plants are placed on each 4 ft. 6 in. stick, the number varying with the size of the plants. It is customary in some places to prime or leaf-cure the first four or five bottom leaves and then stalk-cure the remainder. This preserves the bottom leaves, which would otherwise deteriorate before the top ones were ripe.

It is essential that the barn should be filled with leaf as uniformly ripe as possible. It should also be filled in one day, but if by chance two days are taken, then the second day's picking should be hung on the top tiers. In all cases if there is any difference in the ripeness of the leaf the most immature should be placed in the top of the barn. On many occasions when labour was scarce I have in the one day partly filled the barn and picked enough leaf to complete filling it the next morning. By this means the leaf was kept in a more nearly even condition. Care must be taken when the leaf is thus allowed to stand over night that it is not piled in heaps more than one foot deep. It should also be in single rows—to prevent heating and allow circulation of air from each side. The partly-filled barn should be left open over night. Tobacco should not be allowed to remain in the sun long enough to scald. Less barn room is required for leaf-curing than for stalk-curing. For splitting stalks in stalk-curing a butcher's meat-chopper, sharpened at the end, makes a first class utensil.

Some Factors Relative to Flue Curing.

From my remarks upon soil it will be evident that as soil and climate may both vary so much, with consequent variation in the quality of the leaf to be cured, that no rule can be laid down which will not at times have some exception in detail, though the same principle is always followed.

Much is known about soils and their varying influences upon the tobacco plant, the physiology of which is so greatly affected by the texture and physical propensities of the soil, accounting to a large extent for the distribution of the different types; but the grade of individual types will depend to an equal extent upon the cultural methods, the kind of fertilizer used, as well as the skill displayed in the curing of the crop. So marked is the influence of soil upon the tobacco that the baby plants really never lose the characteristic influence which the soil of the seed-bed had upon them. This influence is traceable right up to maturity.

A rich heavy soil will produce a big heavy coarse leaf, suitable only for heavy dark plug manufacture, and, of course, quite unsuitable for cigarettes. A light-coloured fine sandy soil will produce a fine yellow silky textured leaf, with small veins and ribs, having a mild sweet aroma, and admirably suited to cigarette manufacture. Such leaf is equally unsuitable for dark plug use.

In some parts of Victoria much has been done in the selection of the most suitable varieties for those parts, while in other new districts a great deal of experimental work is needed. The aim of the growers in each locality should be to produce uniformity of type.

Chemical and Physical Changes which Influence the Flue-curing Process.

The art of flue-curing tobacco in this state is a new one to most growers, and is not thoroughly understood by many. It is not merely the drying out of the leaf, but is a prolongation of a life process of maturity. Under favorable barn conditions life is continued until complete, or maximum maturity is reached, and certain important changes take place in the component elements of the leaf during the course of curing under warm and moist conditions.

The analysis of the cured leaf shows different properties and compounds from that in the green state. If the tobacco is dried out too suddenly it is evident to any intelligent grower that these changes do not take place, and the product is rendered worthless. The evaporation is at first prevented by humid conditions, and later allowed to take place slowly. In this process chemical and physical changes take place. The chemical changes are brought about by natural fermenting agents called enzymes, to which are attributable the texture, aroma, and colour of the finished article

During the curing, in the presence of light, sugar, starch, and essential oils are formed. Later on some of this starch is converted by an enzyme known as diastase into a sugar which is derived from the protoplasm (contents of living cells), and which latter is known to chemists as proteids. This protoplasm is similar in composition to albumen, or white of egg. It has the power of spontaneous movement, and continuous changes of form such as no other fluid possesses, and is found in all cells in which food is being assimilated, or where new tissue, or structure, is being formed. It is in this protoplasm, too, that chlorophyll, or the green colouring matter of the plant, is found. This green colour is changed to yellow during the proper conditions of curing, and this is due to one of these enzymes known as oxidases.

There is a marked loss of dry matter, as well as of water, during this curing period—nitrates, protein, and starch decrease. The loss in the two former is brought about by enzymes, while some of the latter is transformed into glucose, and this is passed back into the ribs and veins, and is oxidized and transpired, or breathed off, as carbonic acid gas and water.

Referring to my remarks upon the effect of colour, texture, and aroma due to enzymes, I wish to here explain that these may seem to conflict with those upon soils and their relation to these qualities. The physical and chemical properties of the leaf have been determined and moulded by the soil upon which it is grown, and it then remains with the curer to continue this development until perfection is reached; and it is by his skill and discretion that the good qualities produced in the field may be furthered and retained in the curing barn and bulk-room.

One of the most noticeable changes during the first two stages of curing is the change of colour from green to yellow. If the leaf is allowed to remain in a continuously moist atmosphere this change will continue on from yellow to brown, and on to almost black. The object of the flue-curing barn is to control these conditions of change. The atmosphere is at first kept quite moist and warm (90°, with 85 to 90 per cent. of moisture), this condition being most favorable to the various desirable chemical and physical changes of the leaf.

When the leaf is what is known as "ripe," it is of a yellow colour, and when this stage has been reached it is desirable to carry on the curing and drying as fast as possible without the use of too much heat. This is accomplished by plenty of ventilation, and currents of warm air. The cold air enters through the bottom vents, and is heated and expanded in the barn by the hot flues. This hot air being lighter than cold, tends to rise up through the hanging tobacco, absorbing more and more of the moisture given off by the leaf, and finally escapes through the vents in the roof.

The rate at which the moisture is given off by the leaves is governed by three factors—heat, light, and dryness of atmosphere. In light, transpiration, or giving off of water vapour through the breathing pores, takes place. Its degree of rapidity depends to a large extent upon heat and dryness of atmosphere. The higher the temperature and drier the air the faster transpiration and drying goes on. On the other hand little or no transpiration takes place in a saturated atmosphere. The hygrometer is used to ascertain the degree of humidity in the barns, and directions for making it are given on another page.

Fig. 9.—Seed-beds in the Making.

It is impossible to lay down a definite rule or degree of humidity to be cultivated under all circumstances, but the following will help and act as a general guide. From the time 95°, or what is known as the yellowing period, is left, there should be at least an additional two points difference shown between the wet and dry bulbs for every 5° rise in temperature. Thus, if there are four points difference at 95°, there would be six points at 100°, ten points at 110°, twelve points at 115°, and so on, the difference becoming more and more as the atmosphere becomes drier.

If the curer finds that his leaf is yellowing rapidly after 95° has been left, he may increase his ventilation, which will necessitate an increase in firing to keep up the desired temperature. This will mean a drier atmosphere, which will be indicated by a greater difference between the wet and dry bulbs of the hygrometer. On the contrary, should he find his leaf is yellowing slowly and is drying too fast, he can reduce his ventilation, which, of course, will render less heat, or firing,

necessary to maintain the required temperature. Further, under such closed-in conditions there will be an increase of humidity and consequent reduction of the difference between wet and dry bulbs.

How to Judge Time to Open Vents.

When the leaf presents a generally light pea or yellowish-green colour to the eye on the opening of the door, it is time to start ventilating. It is always advisable to inspect the colour of the tobacco in daylight rather than at night, when the leaf always appears greener. The course of procedure must then be determined. If the leaf is yellow the vents should never be partly closed to help to increase the heat. This will bring about a moister condition of atmosphere, and cause sponging or discoloration on the face side of the leaf.

It is generally said that it is better to go too slow than too fast. This is true, but most curers go much too slow, which accounts for so much dark tobacco in the cure.

There can be no fixed time for any of the various stages of curing, as each barn-full varies more or less in ripeness. Leaf harvested after a dry spell of weather will cure faster and better than that picked immediately after a wet spell; therefore, it is always advisable to leave tobacco in the field for at least a few days after the rain has gone. Leaf picked after a long rainy spell requires slower treatment in the barn, to allow it to ripen up as much as possible before starting the drying. Particular notice must always be taken of the condition of the leaf especially when the vents are first opened, for the knowledge gained will be a guide in future curings. If the first cure turns out too dark it will indicate either that the yellowing process was carried too far or that the drying was too slow. On the other hand, if the cure is too green, one will know that there was not sufficient moisture in the barn in the first stages of curing, which probably caused the leaf to dry out before it had attained the desired stage of yellow.

Ripe leaf, which has been cured with a slight shade of green in it (especially around the butt end of the leaf) after being properly bulked, will come out a better and clearer colour, than leaf which was finished the desired colour in the barn.

The Curing Process.

Tobacco grown on light sandy soils is much easier to cure a good colour than leaf that has been grown on sandy loam or heavy silty soils. It will yellow up better and more evenly in the field, while in the barn it will not change colour to brown or mahogany, as readily as the heavier types. Therefore, in most cases, during the first stages of curing it can be brought to almost lemon yellow colour before the vents need be opened. It will cure faster and stand more heat in the drying, without reddening, than heavier bodied tobaccos.

Tobacco grown on sandy loam is heavier in body than that grown on sand; it takes longer to dry, and consequently the drying must be started earlier. It will be realized that the colour continues to change as long as any moisture remains in the leaf, and, therefore, such tobacco is naturally inclined to cure a light mahogany or brown colour. But if care be taken in the curing, a much brighter colour can be obtained. In dealing with leaf which has fully ripened in the field, sometimes only a few hours are required for the yellowing process, before the vents need be opened and the second stage of curing commenced.

Tobacco grown on rich river flats and silty loams requires a special process to make the best of the little colour obtainable. It is more inclined to cure dark mahogany or brown than either of the former types, owing to its composition. It must be leaf-cured to give the best results. In the yellowing process, it is necessary to give the yellowing a start of only about twelve hours, when some ventilation should be given for the purpose of getting rid of as much of the sap as possible, without using too much heat; that is, the yellowing and drying are carried on more or less together. In other words, if the leaf is yellowed up in a very moist atmosphere, it will be found impossible to get rid of the moisture out of the leaf before it has had time to turn brown. This explains the reason why tobacco hung on scaffold is sometimes a good colour, sometimes even better from a colour point of view than tobacco, cured in a barn, which is not adequately ventilated.

Absolute control of evenly distributed heat is necessary in all curing much more especially in curing this type of leaf. Many of the barns now in use are lacking in this essential detail, which must be supplied

Fig. 10.—Another Satisfactory Seed-bed.

before the best curing results can be expected. While the leaf is on the scaffold transpiration and drying are going on day after day, giving time for the changes in colour to take place by the time the leaf is dry. This natural curing process should be an object lesson to those who are curing tobacco grown on such rich dark soil.

Points on Yellowing.

Tobacco will ripen up or get yellow at temperatures varying from 40° to 120°, but with mature leaf, it is usually found that from 90° to 100° is the most suitable. At the commencement of a curing, if the temperature be gradually raised to 100° or even 105° in from four to six hours, and left at that point for only half an hour or so, which will be sufficient to warm the tobacco and barn through much quicker, and then lowered to about 95°, a desirable sweat, or humid atmosphere is brought about more quickly than by raising the temperature to 95° and allowing it to remain there.

The Curing of Different Types of Leaf.

I shall now endeavour to lay down a generally consistent principle for curing the different types of leaf suitable to certain soils.

After the barn has been filled with uniformly ripe leaf, all picked in one day, and placed in the barn before wilting—for the yellowing process should be completed while the leaf is still crisp, fresh, and full of sap—all vents and doors should be closed tightly and the fires started at once, preferably in the evening, as this gives the maximum proportion of daylight for working operations during the entire cure.

Formula for Yellow Cigarette Leaf Grown on Light Sandy Soil.

Yellowing Process.—The temperature must be gradually raised to 95° Fr. in about four hours, and kept at about this degree until the bulk of the leaf has attained a light pea-green colour, or is about three parts yellow. This usually takes from 15 to 30 hours from the starting point. During the whole of this period the atmosphere should be kept nearly saturated with vapour, showing from two to four degrees between the wet and dry bulb of hygrometer. This can be done by applying water to the floor and flues, though the leaf should supply its own moisture if the barn is airtight.

When the leaf has attained the desired light pea-green colour, the temperature may be raised at the rate of 2½° per hour until 100° is reached. The roof ventilators should then be opened about 3 inches, and the bottom vents should also be opened slightly. The temperature should be brought to 110° in four hours, and when this degree is reached all the ventilators must be opened wide, both in roof and at floor level, and they should remain thus. At this stage, when the leaf is yellow, no sweat should be allowed to accumulate in the barn, for such would cause a reddish-brown colour to appear on the surface of the yellow leaf, known as "sponging." This is an indication that greater and earlier ventilation is needed.

Fixing Colour.

The temperature should be kept at 110° until the tips of the leaves show signs of curling up with a bright yellow colour; the heat should then be increased at the rate of 2° per hour until 120° is reached, and it must remain at this point for about eight hours, or until the leaf is about half dry. At the end of this time, the bulk of the leaf should be of a lemon yellow colour. The temperature must then be brought to 130° at the same rate as previously (2½° per hour), and it should remain about this point until the web of the leaf is dry. Should the leaf show any sign of reddening (usually at the edges and thin parts of the leaf), the temperature should be lowered 10°, and after a few hours it can be increased again to 130° at the rate of 2° per hour.

When the web of the leaf is dry, the vents should be half-closed both top and bottom, and the temperature raised at the rate of 5° per hour until 170° or 180° is reached; this will dry midribs or stalks, which should become brittle enough to break or snap when bent. The vents should be closed during the last few hours of drying.

From three to four days will be required to complete the curing of a barnful of cigarette leaf.

Curing Tobacco Grown on Sandy Loam.

Tobacco grown on sandy loam is slightly heavier in body than that grown on light sandy soils, and therefore must not be expected to make

fine, lemon-yellow cigarette tobacco, though often fine-coloured leaf is nevertheless produced, the colour and texture varying with the proportion of sand in the soil and the conditions under which it is grown.

The method to be adopted in curing this class of tobacco will lie between those used for cigarette and dark leaf. The more siliceous sand a soil contains, the faster will be the method of curing required, while the nearer the soil is to silt or clay the slower should be the process. The following will be the best formula for ripe leaf grown on the above-mentioned sandy loam soil:—

As soon as the barn is full, start the fires and raise the temperature to 95° in four hours (100° will do no harm for a while, and then dropping back to 95°). After the temperature has been kept about 24 hours at 95° the leaf should present a pea-green colour, or about half yellow. When this colour is obtained, slightly crack the vents in roof and at floor level, and gradually raise the temperature at the rate of 2° per hour, until 110° is reached, when all vents should be opened to full capacity. Let the temperature remain at 110° until the tips of most of the leaves have curled up; then advance, in two hours, to 115°, and let it stay at this degree for about three hours; then raise the temperature again to 120° in two hours, and keep it at this degree until the web of the leaf is nearly dry. At this stage there will be about 1½ inches of the web, bordering the midribs, that will still be soft. When this degree of dryness is reached advance temperature to 125°, and keep it at this point until the web is completely dry, when the temperature may be raised 5° per hour to 170° or 180° to complete the drying of midribs.

During the first stages of this process, the humidity must be treated as in the way prescribed for cigarette leaf. The leaf in this case should not be allowed to yellow up to the same extent as cigarette leaf, as it will not "hold on" to this colour long before starting to mottle or turn brown. It is necessary, therefore, to commence getting rid of the moisture long before the leaf has attained a yellow colour.

Only a shade of green should be in the leaf when 110° is left. That is, it should be more of a yellow, or yellow mottled with brown; it should not be of a decided green. It will take about four days to cure a barnful of tobacco of this type.

Curing Heavy Tobacco.

Tobacco that has been grown on rich, brown, river flats requires a much slower process of curing than leaf grown on light loams or sandy soils. Some such tobaccoes grow so rank that the leaf really never acquires a yellow colour, but turns directly from green to yellowish brown, and in such cases only a dark mahogany can be expected.

Barns should be fitted with ample flues, so that all parts can be evenly heated, an essential factor for even curing and drying. When a barn-full of such tobacco, as grown on the above-mentioned soil, is uniformly ripe, it will produce good mahogany colours if cured by the following formula:—

Formula for Mahogany Tobacco.

Start the fires as soon as the barn is full, and proceed as with other types, by raising the temperature to about 95°, and let it remain, without ventilation, at this degree from 12 to 24 hours. During this period the atmosphere must be kept moist, as in the case of yellow tobacco, with from 2° to 4° difference between the wet and dry bulb of hygrometer.

After, say, eighteen hours the leaf will have changed to a lighter shade of green, and at this stage the vents, both in the roof and at ground level, should be opened about 2 inches, which would give a total of 2 2-3 sq. feet opening in roof and about 1 sq. foot at ground level. The heat should be retained at 95° until the leaf has attained about a half-yellow or mottled colour, when the vents should be opened to their full capacity, giving about 16 sq. feet in roof and about 8 sq. feet at ground level. The temperature should then be gradually raised to 110° at the rate of 1° per hour, and kept at 110° until the leaf is about half dry, when the temperature should be raised to 120° at the rate of 2° per hour. It should remain at 120° until the web of the leaf is all dry except a strip along the veins and midribs, when the temperature may be raised to 125° and left at this point for a few hours to complete the drying of the web of the leaf. It should then be increased at the rate of 5° per hour until 180° is reached, and kept at this degree until the midribs are thoroughly dried out

In curing heavy tobacco, careful attention should be paid to the first stages of the process. The earlier the yellow colour appears in the leaf, the sooner the vents will require opening, and as the yellow colour increases, so the ventilation will have to be increased. As I have already stated, the drying and curing go on simultaneously; therefore some experience and practice is needed to just finish drying the web by the time the best colour is obtained, which is usually from bright to dark mahogany.

It usually takes from five to seven days to complete a barn-full of this type of tobacco

Curing Late Crops.

It sometimes happens that cold weather sets in early in the autumn, preventing late crops from reaching full maturity before the danger of frost is at hand. In such cases it is best to hang the tobacco in the barn, and maintain a temperature of about 85° to 90° until the leaf has shown signs of yellowing, which usually takes about 36 hours, and then gradually raise the temperature to 110° in ten hours. At this stage, if the leaf has taken on a yellow colour and has the appearance of curing out bright, the same method should be adopted as for ripe leaf off similar land, but the process should be slightly slower. If, on the other hand, the leaf gives evidence unfavorable to the production of bright colours, and is likely to be a mixture of green and brown, it is better, after obtaining a fair yellow colour, to raise the temperature to 115° or 120° in about eight hours, with the vents closed. When this degree is reached, if the atmosphere be very moist, the vents should be opened about 2 inches top and bottom. This will prevent "sponging," and at the same time hold enough moisture in the barn and the leaf to bring about a faster change of colour to a reddish brown. Drying may then be proceeded with as in the cases already dealt with. Manufacturers object to immature tobacco in any form, but when cured a reddish brown it is more acceptable than when presenting a green colour.

Ordering, Bulking, and Grading.

After the stalks and stems are thoroughly dried out as mentioned above, all doors and ventilators should be opened wide to allow the tobacco and barn to cool down. The flues may be covered with wet bags or with straw, taking care that it does not touch the hot brickwork or

flues near the brickwork, as there is danger of it firing. It is better to use a wheat bag at furnace end of flue, keeping it about 1 foot distant from the bricks.

The still warm floor may be thoroughly wetted. It is also a good plan to hang wet bags about the basement walls, the aim being to make the atmosphere moist. In a saturated atmosphere tobacco will come into order in a couple of hours on an average, while it will take four or five hours to accomplish the process under ordinary conditions.

As too much moisture in the leaf tends to darken it, and also makes favorable conditions for mould, it is essential that the leaf should not remain in a moist atmosphere too long. It is a better plan to take it down and put it in bulk just before it is soft. There should be a slight cracking in the lateral veins when squeezed in the hand; at the same

Fig. 11.—Hands or Bundles of Tobacco.

time the midribs should be brittle enough to break when bent for about one half of their length. Bulked in this condition, the leaf will even up in softness, and there will not be much danger of mould, provide the bulk room is compactly built and is capable of resisting the outsi wet conditions that sometimes prevail, and is at the same time capable of holding the necessary moist atmosphere to carry on the ferments and handling.

Tobacco should not be bulked on or nearer than 1 foot of the ground, as it absorbs moisture readily, and will soon go mouldy. It is a good plan to make a bench of logs or boards, with air space underneath. This bench should be covered with straw before starting bulking operations. To bulk tobacco, it is usual to lay two rows of leaf with butts of midribs outward, allowing the points of the leaves to lap about one-third of their length. The bulk may be made to any convenient length and height.

After each lot is bulked it should be covered thoroughly with rugs or bags, and weighed down tight to prevent drying.

It is not a good plan to allow leaf to soften in winter weather. If it is too dry it is better to hang it in the barn, and order as mentioned above. If leaf has become too soft, it should be hung in the barn and dried out thoroughly before re-ordering.

Stalk-cured tobacco is usually bulked down on the sticks. This necessitates making the bulk 4 feet wide and usually from 8 or 12 feet long.

After each bulking the room should be closed. When necessary, the floor of the bulk room should be sprinkled with water. This is nearly always necessary in dry weather. This will prevent the bulks from becoming too dry, and also will assist in the removal of any green. Every time tobacco is moistened and dried out again it changes a shade of colour, usually from green to yellow, and thence to brown, and finally to almost black.

It will be seen from the foregoing remarks that it is not advisable to bulk yellow or bright tobacco along with considerable quantities of green

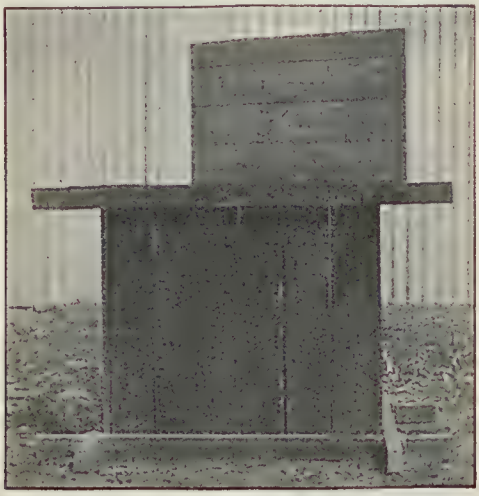

Fig. 12.—Box in which Handed Tobacco is pressed.

leaf. The fact that the longer yellow or any good tobacco is kept exposed to continual atmospheric changes, the more it will change in colour and depreciate in value, is evident.

After a good coloured leaf has been bulked down for five or six weeks, it is ready for market. If it cannot be sold, it should be bailed and put away in a dry place to prevent further changes in colour taking place, while leaf still containing a little green should be kept in a warm, compactly-built room, so that a humid atmosphere can be made when required.

Pipe and cigarette tobaccoes while in bulk in a warm room go through a mild fermentation, which improves them in colour, texture, and smoking quality. After the leaf has gone through the desired sweat or fermentation, it should be graded into at least six grades, namely—

No. 1. Lemon-yellow, which consists of the good large yellow-coloured leaf.

No. 2. Yellow, consisting of small and damaged leaf of a good yellow colour.

No. 1. Bright mahogany, consisting of large leaf, sometimes yellow mottled with brown, or of a light mahogany colour.

No. 2. Bright mahogany includes any small and damaged leaf of a bright mahogany colour.

No. 1. Dark mahogany includes all dark tobacco of good size and quality.

No. 2. Dark consists of all small and damaged leaf of fair quality.

While the leaf is being graded it is tied in bundles or hands of about fifteen leaves by arranging the butts evenly and binding them tightly together with a leaf around them for about 2 inches; the tie may be fastened by slipping the end of this leaf through the hand. Some farmers re-bulk these hands, while others pack them directly into the hessian bales which are usually made 3 ft. 6 in. long by 2 feet wide, and 2 feet high. Figure 11 shows the manner in which the hands or bundles are made.

Fig. 13.—Baled Tobacco Ready for Market—Opened Press at back.

Figure 12 shows a box in which the handed tobacco leaf is pressed ready for market. The two sides are 3 ft. 6 in. wide and about 4 feet high, and the ends are 2 feet wide and 4 feet high. The ledges are usually made of 4-in. x 2-in. hardwood, projecting about 1 foot over each edge. These ledges are notched or checked out, so that the end ledges will drop into the side ones when the four sides are stood up in position. The notches at the angles should not fit tight, but should have room to allow for the insertion of wedges in each joint.

Fig. 13 illustrates a finished bale of tobacco leaf branded ready for market.

The pressing is sometimes done with a lever or 8-in. pole, 20 feet long, inserted and pinned into a tree or post at one end. This pole is lifted up out of the way while the box is being filled with leaf, and the lid, which should be of strong hardwood boards, is being placed on top. After placing packing pieces or blocks upon the lid, the lever is brought into operation, and by pressing on the long purchase end, the leaf, which previously filled the box, will be brought down to 2 feet, which is the

regulation width and height of a bale; the length should be 3 ft. 6 in. However, the common method is to make a suitable frame, or to set two posts in the ground with sole plate, and to these posts a suitable head bar, about 6 in. x 6 in., is attached, so that a screw-jack may be used. Such an arrangement is shown in Fig. 14. Suitable strips of hessian are placed in the bottom of the box and under the lid before pressing. These pieces should be brought together and sewn while the weight is still on and after the box is removed.

How to Make a Hygrometer Suitable for this Work.

Take two evenly graded thermometers, and fix them side by side on a piece of board. To the bulb of one of these fasten one thickness of a strip of muslin tightly around the bulb, and secure it at top and bottom by tying with thread. Cut this wick off about 3 inches below the bulb, wet the whole and allow about 1 inch of it to enter and remain in a cup of clean water. The water from the cup is drawn upwards through the wick to the bulb; thus this bulb is being kept constantly

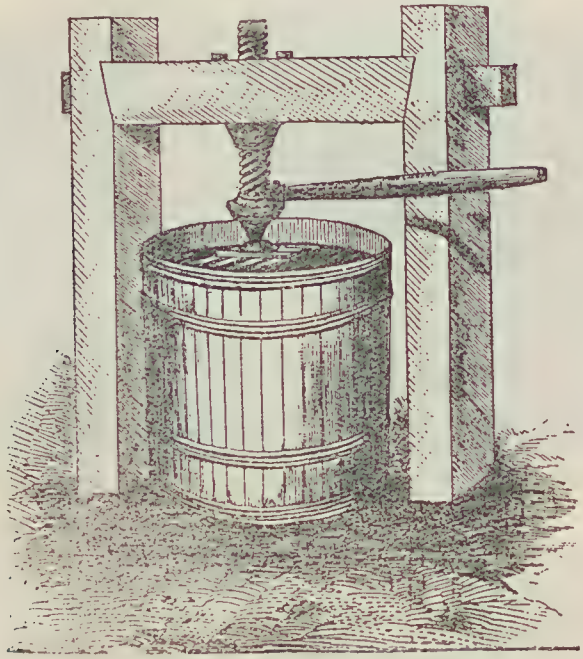

Fig. 14.—One Type of Tobacco Press.

moist, while that of the other thermometer remains dry. The water on the surface of this wet bulb will evaporate more or less rapidly according to the dryness of the atmosphere surrounding it. The more moisture the air contains, the less rapid will be the evaporation, and vice versa. When the two thermometers register alike, the atmosphere is said to be saturated, and no evaporation takes place.

It is desirable to keep as near saturation point as possible during the yellowing process, especially in its first stages; later 3° or 4° difference is permissible. It is important that the hygrometer should be hung among

the tobacco, where a true registration of the heat and moisture can be recorded.

Proper degrees of heat, light, and humidity are the fundamental and essential factors in curing good tobacco.

Some Varieties of Tobacco Grown in Victoria.

For Pipe and Cigarettes When Grown on Light Soils.

Hester
Gooche
Bonanza
Yellow Oronoco
White Stem Oronoco
Little Oronoco
Silkey Pryor
Yellow Pryor
White or Medley Pryor
Warne
Bradley
Conqueror
Flanagan
Goldfinder
Saffron
Honduras
Smyrna
Goldleaf
White Burley.

For Dark Smoking Tobacco When Grown on Heavy Land.

Kentucky Yellow
Big Oronoco
White Stem Oronoco
Blue Pryor
Lacks.

Fig. 15.—General View of a Field of Ripe Tobacco.

MAFFRA CROP COMPETITIONS.

Report of the Judge, L. C. Bartels, B.Ag.Sc., Science Field Officer.

The institution of Crop Competitions by the Maffra Agricultural Society is a forward move. The value of such competitions has been amply demonstrated in the wheat-growing areas of the State, and every year they are becoming more popular. They are the means of stimulating better agricultural practice and are an educative force, inasmuch as they lead to an analysis of the methods by which the most successful farmers secure their results. The information gained is disseminated for the benefit of all and the results of experimental investigations in regard to cultural practices, manuring, combating disease and plant-improvement have, in most cases, been referred to in the judge's reports.

Because of the diversified farming carried on in the Maffra district, the society had a more difficult task than most societies, and no fewer than five sections were included in the competition:—Irrigated Beet Crop; Unirrigated Beet; Maize Crop; Lucerne; Oaten Hay-Stack; and Lucerne Hay-Stack.

The number of entries was not large. Still, there were sufficient to encourage the Society to continue its efforts. It was suggested by Messrs. Millier and Tucker, the prime movers in these Competitions, that they might lead up to general farm competitions. I should recommend, however, that, for a while, the Society should confine its attention to crop competitions and endeavour to popularize them.

Beet.

The extent of the beet-growing industry at Maffra is limited by the capacity of the factory and it is estimated that 30 per cent. more would be grown if no restrictions were placed on growers. This indicates that the industry has a bright future, particularly when the advent of irrigation will assure good yields, even in dry seasons. The land at Boisdale would seem to be particularly well adapted for irrigation. At Tinamba heavier land exists, and the one irrigated crop of beet inspected there showed that too much water is a detriment in a season such as this one. Definite information can be gained only by experience in a particular locality, but it may be affirmed that moderate irrigation is always better than heavy irrigation; particularly does this apply to beet, on which water will have a big influence as to its shape and sugar content. Care taken in grading the land for the reception of water is always well repaid, and proper drainage is necessary. It is probable that furrow-irrigation will be the method resorted to in watering beet.

As indicated below, heavy crops of beet were grown this year on unirrigated land. The value of good cultivation and clean crops is generally recognized. One competitor advocated 3 cwt. of superphosphate as a suitable dressing of manure for a beet crop, and it is probable that the value of liberal applications will be demonstrated by experiments.

The analyses of the beet inspected during the competition were made by the Chemist of the Maffra Sugar Factory.

Maize.

The maize crops inspected were all very good, well developed, upstanding, and bearing well-filled ears of good shape. Cold weather prevailed at the beginning of the season and retarded growth then, but favorable rains fell during growth and high yields are promised. The maize was rather immature for judging and proper comparisons could not be made with regard to the period of ripening, husk protection, weather resistance, ease of picking, character of grain, &c.

Yellow Dent maize was the only kind seen. It is considered to be adapted to conditions at Boisdale. The particular varieties were unknown, but they seemed to be of good type.

No manure was used, but its effects should be tested; it is not unlikely that superphosphate would have an influence in the direction of hastening maturity.

When irrigation water is available there will probably be a big extension in maize-growing throughout the district. It is considered very profitable.

Furrow-irrigation is the correct method of watering maize and moderate irrigation with frequent cultivation should be the rule. Intertillage with suppression of weed growth is of the utmost importance.

The quality of the maize crop is maintained by the selection of good seed ears, but inasmuch as this is always done from the crib without regard to the plants on which the ears are borne, little improvement is effected in this way. Moreover, the silks of the maize catch the wind-borne pollen which comes alike from the tassels of good and bad plants in the crop. The result is that every maize crop is a collection of very many types of plants, and there is no uniformity in the ears produced. The production of uniform types of improved quality can be achieved, but by a difficult process involving in-breeding of superior strains and subsequent re-crossing.

Every farmer should select his seed, preferably from the ripened crop and with due regard to weight and shape of ear, depth of grain, husk protection from weather and disease, thickness of shank (which may prevent the ear from hanging down), &c. A strong upright stalk on the mother plant should be looked for and the height of the ear on the plant observed.

Hay-Stack Building.

In the Stack Competition the scale of points drawn up allowed 50 of the possible 100 points for quality of the hay contained. The Society's object is to encourage the production of good fodder as well as proficiency in stack-building.

Symmetry in outline usually indicates a good stack, but the primary purpose in stacking is storage in such a way that minimum damage is possible from the weather, vermin, &c. Construction must be carried on in such a way that all the fodder is inclined downwards towards the outside. The importance of keeping the centre of the stack well packed is obvious—by keeping it raised some inclination is given to the hay.

It is plain that the roof is the main feature governing protection from rain. The steeper the slope of the roof, the better will water be turned, and if a good eave row projects most of the drainage will run clear of the sides, but if the stack has been so constructed that

the fodder has settled with the straws having an inclination to the centre, water will be absorbed with consequent damage to the hay.

Some good builders have abandoned the practice of "kneeing" the outside rows of sheaves. They maintain that tight packing of the inner rows will better achieve the desired slope.

The practice of "springing" a stack, that is, increasing its width as the construction proceeds, will, undoubtedly, help to turn rain from the sides.

Thatching provides protection from the weather, but it will not make up for poor building; on the other hand, a well-constructed stack will turn rain even though unthatched.

Protection from mice may be very important and unless a proper base for the stack is used some loss is inevitable.

Lucerne.

Many factors govern the production of good lucerne hay. Wet weather experienced during harvest is likely to affect the quality in spite of the best efforts, but there are several conditions which may be controlled; such are the choice of variety; the maintenance of a good stand; the extent of irrigation; time of cutting and harvesting methods. Definite evidence for the guidance of lucerne-growers has been deduced from the investigations at the Werribee Research Farm.

In tests of fifteen varieties over several years, Hunter River lucerne has been shown to be the most productive, but French Provence lucerne produced hay of superior quality (it, however, yields from 10 cwt. to 1 ton less per annum than Hunter River). A feature of the Hunter River variety is that it makes better growth in winter.

Several other varieties resemble these two in character, but they do not excel.

Under irrigation the quality of lucerne hay varies with the quantity of water applied. It has been shown that the yield will be increased by added water even up to 4 feet during a season, but the hay produced under such heavy irrigation is inferior, and much better hay is grown when 2 feet of water is used in 4 or 5 inch applications during the season.

The time at which lucerne is cut has an important bearing on quality of the hay as well as on production and it is in this regard that many farmers err. If a lucerne stand is cut when *one-tenth of the plants are in bloom* it gives the highest yield. The hay at that stage is good, but as the bloom develops the stems become coarse and woody, the leaves drop, and if moisture is available the shoots of the succeeding crop are well forward. The appearance of these shoots at the base of the plant is the best guide as to when to cut.

In harvesting lucerne, every effort should be made to save the leaves. Cutting at the right stage is necessary, but it calls for the exercise of judgment as to how long the mown hay should lie in the swathe, in the windrow and in the cock. It should be remembered that curing is not mere drying. It should be gradual. A properly-made cock permits aeration and provides better protection against discoloration and leaching of soluble matter from the leaves by rain.

The loss of leaves in carting and stacking is greatly reduced, if lucerne has been cocked and the natural green colour will be better preserved.

A thin stand, besides being less productive than a thick one, will make a coarser growth, and often grass and weeds will abound in the crop.

Points Awarded in Various Sections.

Section 1.—For the Best 5 Acres of Beet (Irrigated).

Competitor.	Tonnage per acre.	Sugar Cont.	Cultivation.	Freedom from Disease.	Total.
Possible Points ..	**50**	**25**	**20**	**5**	**100**
C. Tucker	40	21	18	4	83

Section 2.—For the Best 5 Acres of Beet (Unirrigated).

Competitor.	Tonnage per acre.	Sugar Cont.	Cultivation.	Freedom from Disease.	Total.
Possible Points ..	**50**	**25**	**20**	**5**	**100**
S. Pearce	48	25	18	5	96
J. D. Gleeson	50	20	15	4	89

Section 3.—For the Best 3 Acres of Maize.

Competitor.	Yield.	Cultivation.	Total.
Possible Points	**50**	**25**	**75**
Mr. McCarthy	45	24	69
M. J. Jessup	50	18	68
B. Carroll	42	23	65

Section 4.—For the Best Stack of Oaten Hay—10 Tons or over.

Competitor.	Quality.	Building.	Weather Resistance.	Total.
Possible Points	**50**	**25**	**25**	**100**
Webster Bros.(Builder, Mr.May)	48	23	23	94
Miss Deary	35	20	20	75

Section 5.—For the Best Stack of Lucerne Hay—10 Tons or over.

Competitor.	Quality.	Building.	Weather Resistance.	Total.
Possible Points	**50**	**25**	**25**	**100**
C. Tucker	42	23	23	88
Webster Bros.	43	22	22	87
J. D. Gleeson	35	19	20	74

Comments on Competing Crops.

Irrigated Beet.

Mr. Tucker presented the only crop of irrigated beet inspected. This crop succeeded maize. After picking the stalks of the maize were dragged down and ploughed under, in June, to a depth of 5 inches. The land was "disced." spring-tooth cultivated and harrowed. In August it was ploughed 10 inches deep with a disc plow and left for a while. It was "disced," spring-tooth cultivated, harrowed, top-dressed with superphosphate 186 lb. per acre, spring-toothed, rolled and sown in October. 11 lb. of seed per acre was put in. The beet was cultivated at least six times, twice before thinning. The plants were thinned to 8 inches in the rows. The standard method of sowing is in rows 18 inches apart.

Very little weed growth was observed amongst Mr. Tucker's crop, and the roots were of regular shape, but on the small side. The rainfall this season was sufficient to ensure good crops without irrigation, and Mr. Tucker watered to the detriment of his crop; a small area was drowned out, but for the most part the crop was regular. A little rust showed on the leaves, but no other signs of disease were noticed.

Usually irrigation is commenced in January. Mr. Tucker's experience this season impressed upon him the great care necessary in irrigating. In his opinion an overhead system of watering would be superior to flooding or furrow irrigation.

Unirrigated Beet.

Mr. S. Pearce, of "Penpol," Boisdale, showed a nice field of beet in the unirrigated section. The crop was clean and fairly regular and will yield nicely-shaped beets of fair size.

The last crop grown on the land was millet. In February the land was ploughed 10 inches deep and again in August 7 inches deep. It was cultivated to a fair tilth and sown at the end of August. The rate of seeding was 12 lb. per acre with 1 cwt. of superphosphate. The crop was in 18-inch rows, thinned to 9 or 10 inches in the row. It was worked with the sweep cultivator seven times before thinning and six or seven times since. The soil has an underlying stratum of gravel and is well drained. Irrigation will greatly benefit it. Mr. Pearce considers that the manure applied might be increased even to 3 cwt. per annum.

Mr. J. B. Gleeson's crop of beet was unirrigated and showed signs of ripening. A few weeds were scattered throughout and some misses were apparent. Some of the roots examined were on the short side. Mr. Gleeson was away from home when the inspection was made and a description of his methods was not available.

Maize.

Mr. McCarthy, of Boisdale, submitted for judging a crop of Yellow Dent Maize of very high merit. It was tall and erect, with well-filled ears. It was somewhat on the late side. The ground was free from weeds. The previous crop grown on the land was maize. The old stalks were dragged into heaps and burnt and the land was ploughed in July with the mouldboard plough to a depth of 4 inches. In September

it was disc-ploughed 7 inches deep, stirred with the rigid-tyne cultivator, harrowed and sown at the end of October. The seed was put in at the rate of 13 lb. per acre, allowing for two and three seeds per drop. The seed was selected by Mr. McCarthy; no manure was put in.

Mr. McCarthy likes the Yellow Dent Maize. He has had no experience with White Maize. During the growth of the crop the land was cultivated six times; the maize was hand-hoed and suckered. It is considered by this farmer that inter-tillage of the growing crop is all-important and that every stroke of the cultivator adds to the yield. Suckering is absolutely necessary, and two or three stalks to the hill should be left; one would be better than four.

The crop of maize shown by Mr. J. Jessup at Newry was Yellow Dent. The land on which it was growing is on the banks of the river, and it had not previously been cropped. The crop was tall and upstanding, with some of the ears too highly placed on the stalks. The ears were well filled and gave promise of a high yield. A considerable amount of "couch grass" (*Cynodon dactylon*) and, in places, swamp paspalum (*paspalum distichum*) was observed.

In preparation for the crop the land was ploughed in October with a disc plow to a depth of 6 inches and afterwards "dragged" with a clod crusher, harrowed twice, again dragged, re-harrowed, and planting was done at the end of October. The rate of seeding was 14 lb. per acre. The crop was horse-hoed three times, hand-hoed and suckered.

Mr. Bernard Carroll showed an area of Yellow Dent maize on land which had borne an oat crop in 1922. In July the land was ploughed 6½ inches deep and subsequently graded, re-ploughed, disc-cultivated, harrowed three times and sowed on 22nd October; 12½ lb. of seed per acre was dropped and two seeds per hill was the thickness of sowing aimed at. No manure was put in; the crop was four times horse-hoed, twice in each direction, hand-hoed and suckered. A fairly good crop resulted. It was tall and upright and bore well-filled ears; there was a fair amount of weed growth between, and "couch grass," goosefoot, Prince of Wales feather and other weeds were seen.

Hay and Haystacks.

Messrs. Webster Bros., of Newry, showed a very regular stack of oaten hay, which was built by Mr. May. This stack contained some 35 tons; it was 37 x 17 feet, and the height of the wall when built was 15 feet. The ridge was high and the roof had a very steep slope. About one-third of the bulk of the stack was contained in the top. The roof was not thatched, but the pitch of the roof-sheaves was such that no rain had entered. A well-defined eave row projected over the line of the base, but there was not much spring in the stack, a feature which Mr. May considers unnecessary. Probing revealed a fair slope on the outside sheaves, and examination of the hay showed that it was of very good quality—clean strawed, sweet-smelling and with plenty of grain. The builder placed the two outside rows in position with his hands, the butts of the hay were kept outwards throughout and the centre of the stack was kept well raised. No provision was made for protection against vermin.

The oaten hay stack, shown by Miss Deary, was not very regular in outline. The hay was of medium quality, containing some weed growth and the stems showed a little rust.

Mr. Tucker showed a particularly neat lucerne haystack of about 13 tons. It was of regular shape; the roof had a low pitch, but it was thatched to ensure weather resistance.

The lucerne was French Provence variety. No weeds were present and the hay was fine-stemmed, but the stems were woody, and leaf-spot in evidence showed that the crop had not been mown at the right stage; an odd patch of mould was observed, but the hay generally was well cured.

Mr. Tucker considers Hunter River more productive than French Provence lucerne. He aims at securing 5 tons of hay—spread over five cuts in the growing season. He cuts his hay when half in bloom, and this year gave only one irrigation—between the second and third cuts. For maintenance of the stand he considers an annual top-dressing of superphosphate advisable, and last year he applied 6 cwt. of burnt lime per acre, which he purposes repeating in about three years. Mr. Tucker endeavours to have his lucerne in the stack three days after cutting—even though some fermentation may occur in the stack. Stock, he says, seems to find " brown hay " the most palatable.

Messrs. Webster Bros. exhibited a lucerne stack containing some 15 tons of hay. The variety was Hunter River and the second cut for the season was in the stack. It was of regular shape with a high pent roof, which had turned rain fairly well. The hay was of good quality with most of the leaf retained, but it had been cut on the late side. Another stack was intended for exhibition, but it was not completed. From this butt a sample of prime hay was submitted for inspection. It showed that Messrs. Webster Bros. fully appreciate the principles underlying good hay-making. They cut the crop just after flowers appear, the hay is cocked and an endeavour made to cart it in five days after cutting. Raking is done in the mornings, and carting is suspended if the weather is too hot. Both Hunter River and French Provence lucerne are grown by Messrs. Webster Bros. They consider the Hunter River variety superior for general purposes.

Mr. J. D. Gleeson's exhibit was a stack of Hunter River. The stack was fairly well built, but the hay contained was only of second-rate quality. It contained some weeds, was rather coarse and apparently had been cut on the late side, although the stems were not too woody.

RESULTS OF POTATO MANURING TRIALS.

(Continued from page 420.)

J. T. Ramsay, Potato Expert.

Millbrook, 1923-24.

The results of the potato experiments conducted at Millbrook during the past season, which are given below, are amongst the most satisfactory ever obtained on any field by this Department. The objectives of the trials were to demonstrate—

I. The effect of various manures at varying rates per acre on the potato crop.

II. The improvement to be gained in the yield by exercising selection of seed.

III. The advantage to be gained by the use of immature instead of ripe seed.
IV. The comparative yielding capabilities of different varieties.
V. The influence of lime on the crop.

The class of soil in which these tests were conducted was a rich red volcanic loam of good depth, which is typical of that belt of potato country in central Victoria extending from Bungaree through Newlyn to Trentham, which from the earliest date of farming in this State has been noted for its production of the finest quality potatoes.

The results given in the following tables are so self explanatory that little need be written about them. It may be said, however, that they demonstrate very clearly that the practice of judicious treatment of the crop is not only much to be commended, but highly profitable. Immaturity in seed and selection of seed stand out in bold relief as two of the biggest influencing factors in potato cropping, and the benefits gained by the observance of these two rules should make a strong appeal to those interested in the industry.

From the tonnages recorded it goes without saying that the season was very favorable to growth. An important feature of the yields was the fact that owing to the departmental practice of dipping seed prior to planting in a solution of formalin (1 in 30) the whole of the crop was free from disease of any sort. The area employed was five acres, four acres being devoted to variety, immature seed and selected seed tests, and one acre to manure trials.

The results obtained from manures indicate that about 3 cwt. per acre is about as much as can be profitably utilized on this class of land. This is supported by the results of the previous years, and is recognized by growers in the district. The wonderful increases accruing from selected seed and the use of immature seed are evidences of the most convincing character of the soundness of these methods, which have long been strongly advocated by this Department.

Manure Trials Results.

Manure per acre.	Limed.		Not Limed.	
	Yield.	Increase due to Manure.	Yield.	Increase due to Manure.
	T. c. q.	T. c. q.	T. c. q.	T. c. q.
No. 1.—3 cwt. super.	17 1 3	5 3 2	17 1 3	4 15 3
No. 2.—6 cwt. super.	16 11 1	4 13 0	16 13 3	4 7 3
No. 3.—9 cwt. super.	15 4 0	3 5 3	16 19 2	4 13 2
No. 4.—6 cwt. super., 1 cwt. sulp. potash	17 11 3	5 13 2	17 12 0	5 6 0
No. 5.—No manure	11 18 1	..	12 6 0	..
No. 6.—6 cwt. super., 1 cwt. ammon. sulp.	15 10 2	3 12 1	18 5 0	5 19 0
No. 7.—6 cwt. supor., 1 cwt. ammon. sulp., 1 cwt. potash sulp. ..	17 1 2	5 3 1	17 7 0	5 1 0
No. 8.—3 cwt. market garden	15 10 2	3 12 1	17 19 3	5 13 3
No. 9.—3 cwt. basic phosphate ..	16 6 0	4 7 3	17 19 1	5 13 1

It will be noted that the lime had evidently a depressing effect on the crop, particularly where ammonia sulphate was used, in plot numbered "6."

The following table is given to show the cash values of the increases from the various manures. The values are calculated at £4 per ton, and the figures are those from the unlimed section of the field:—

Increased Cash Revenue from Manuring.

Manure per acre.	Yield.	Cost of Manure.	Increased Value.	Net Increase.
	T. c. q.	£ s. d.	£ s. d.	£ s. d.
No. 1.—3 cwt. super.	17 1 3	0 13 6	19 3 0	18 9 6
No. 2.—6 cwt. super.	16 13 3	1 7 0	17 11 0	16 4 0
No. 3.—9 cwt. super.	16 19 2	2 0 6	18 14 0	16 13 6
No. 4.—6 cwt. super., 1 cwt. sulp. potash	17 12 0	2 2 0	21 4 0	19 2 0
No. 5.—No manure	12 6 0	Nil	..	..
No. 6.—6 cwt. super., 1 cwt. ammon. sulp.	18 5 0	2 5 0	23 16 0	21 11 0
No. 7.—6 cwt. super., 1 cwt. ammon. sulp., 1 cwt potash sulp ..	17 7 2	3 0 0	20 4 0	17 4 0
No. 8.—3 cwt. market garden	17 19 3	1 4 0	22 15 0	21 11 0
No. 9.—3 cwt. basic phosphate ..	17 9 1	0 14 3	22 13 0	21 18 9

The next table shows an interesting comparison of the manure cost for each ton increase, of the various manurings, and is a striking illustration of the profit obtainable from manures, even in a season of low prices.

Cost per Ton Increase of the Various Manures.

Manure per acre.	Yield.	Increase.	Cost of Manure.	Cost per ton Increase.
	T. c. q.	T. c. q.	£ s. d.	£ s. d.
No. 1.—3 cwt. super.	17 1 3	4 15 3	0 13 6	0 2 10
No. 2.—6 cwt. super.	16 13 3	4 7 3	1 7 0	0 6 3
No. 3.—9 cwt. super.	16 19 2	4 13 2	2 0 6	0 10 5
No. 4.—6 cwt. super., 1 cwt. sulp. potash	17 12 0	5 6 0	2 2 0	0 8 4
No. 5.—No manure	12 6 0	Nil	Nil	Nil
No. 6.—6 cwt. super., 1 cwt. ammon. sulp.	18 5 0	5 19 0	2 5 0	0 7 6
No. 7.—6 cwt. super., 1 cwt. ammon. sulp., 1 cwt. potash sulp. ..	17 7 2	5 1 0	3 0 0	0 11 8
No. 8.—3 cwt. market garden	17 19 3	5 13 3	1 4 0	0 4 2
No. 9.—3 cwt. basic phosphate ..	17 19 1	5 13 1	0 14 3	0 2 6

Varietal Returns.

	T. c. q.
Earliest of All	11 3 0
Red Ohio	9 15 0
Manhattan	8 5 0
Brownells Beauty	13 11 0
Browns River	13 10 2
Carmen I.	14 9 3
Duchess	14 15 0
Minato	15 18 1
Carmon III.	18 2 1

Results of Immature *v* Ripe Seed Trials.

Class of Seed.	Immature.	Ripe.	Increase due to Immature Seed.	Increased Value per acre.
	T. c. q.	T. c. q.	T. c. q.	£ *s.* *d.*
Carmen III. unselected	16 15 0	15 5 2	1 4 2	4 18 0
Carmen III. from plants giving ten and over	20 8 3	18 2 1	2 6 2	9 6 0
Carmen III. from plants giving seven and over	19 0 2	17 14 2	1 6 0	5 4 0

It will be seen that the immature seed consistently performed better than the ripe seed, yielding on the average over 1½ tons increase—a very material difference.

Selected Seed Results.

Variety.	Unselected.	Selected.	Increase due to Selection.
	T. c. q.	T. c. q.	T. c. q.
Manhattan	8 5 0	11 19 2	3 14 2
Brownells Beauty	13 11 0	16 15 3	3 4 3
Minato	15 18 1	18 2 1	2 4 0
Carmen III.	17 1 3	20 8 3	3 7 0

This affords a very striking result of the benefit to be derived from the selection of seed. On the four varieties tested, an average increase from the selected seed was obtained of from 1 to 3 tons per acre, or an average of nearly 25 per cent.

This is a practical demonstration of considerable value to growers of a simple method whereby they can greatly improve their yields at practically no increase in cost.

POULTRY BREEDING.

Experiments in Incubation.

W. C. Rugg and W. O. Pederick.

Many inquiries are received each breeding season as to whether it is necessary to use moisture when hatching eggs in incubators, and also as to how many times a day the eggs should be turned while in the incubator, to obtain the best results. The following report on experiments, conducted at the Werribee State Research Farm in October, 1923, contains answers to both questions.

Three cabinets were used in an Austral Mammoth coke-burning incubator, and every care was taken to have the conditions as to temperature and ventilation equal in each cabinet. The incubator room is well built, perfectly ventilated, and has a concrete floor. The number of eggs used was 363, all laid by white Leghorns, and they were divided into three lots of 121 eggs each.

The eggs put into No. 1 cabinet were not touched till the third day. From the third to the nineteenth day they were cooled once a day and turned five times a day. The time of cooling was five minutes on the fourth and fifth day, and this period was gradually increased until during the last few days it reached half-an-hour. The eggs were not touched from the nineteenth day till the hatch was over. The machine used was equipped with an automatic egg turner, by which the eggs could be turned without opening the drawer. On the third day the moisture tray was placed in the cabinet and kept full of water throughout the hatch.

The eggs in No. 2 cabinet received exactly the same treatment as those in No. 1, except that no moisture tray was put in.

The eggs in No. 3 cabinet were dealt with in the same way as those in the other two, except that they were turned only when they were being tested for fertility, on the fifth and fourteenth days.

Details of the hatches are as follow:—

Eggs Put in 2nd October, 1923; Due to Hatch 23rd October, 1923.

Cabinet.	Number of Eggs.	1st Test on 7.10.23.	2nd Test on 16.10.23.	Number of Fertile Eggs Remaining.	Hatched.	Cripples.	Chipped and Died.	Died in Shell.
No. 1 ..	121	23	15	83	62	1	1	19
No. 2 ..	121	28	13	80	56	3	6	15
No. 3 ..	121	22	15	84	30	3	16	35

The conclusions to be drawn from the experiments in the No. 1 and No. 2 cabinets are that under such conditions the use of moisture showed a slightly better result. The air cells were watched closely, and marked at different stages; but there was apparently no difference between the two cabinets.

The results from the No. 3 Cabinet show the necessity of turning eggs regularly. The number of chickens hatched was unsatisfactory, and many of them were weak, a large percentage dying during the brooding period.

The method of hatching followed in the case of the No. 1 cabinet proved satisfactory at the State Research Farm during the 1923 season; 4,000 chickens were hatched, and the average number of chickens hatched from the fertile eggs was over 85 per cent.

The breeding season there ends with September, as experience has shown it to be inadvisable to hatch chickens after the end of that month. This belief is supported by the poor results obtained from the No. 1 cabinet (the eggs being put in on 2nd October), as, although they received exactly the same treatment as those incubated earlier in the year, the percentage of chickens hatched was considerably lower.

NATIONAL MUSEUM MELBOURNE

Famous

"Pilca-Butta"

Strain

of

Hunter River Lucerne

(THE FINEST IN AUSTRALIA)

For Quality, this Lucerne repeatedly tops the market price in Sydney.

This Seed was selected by the N.S.W. Government as the sample sent to London for the British Empire Exhibition, for exhibition of Australian Products.

We have again secured the whole crop of this fine strain, and customers can therefore be assured of getting the genuine Broad-leaved Hunter River Lucerne, passed by the Government here as being free from Dodder and other weeds.

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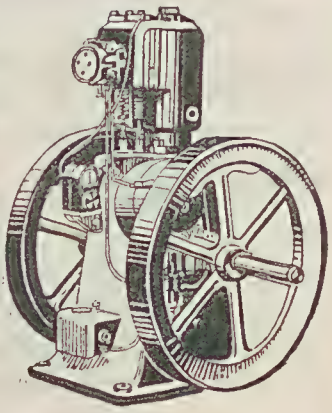

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(1) Bull Calf *ex* Dominion Hyacinth (374)

Dropped 29th August, 1923

Sire: **Victoria Songboy (359)** by Dominion Domino Dutch Boy (73 F.H.B.A.), *ex* Dominion Madrigal (371 F.H.B.A.).

Sire of Dam: **Oak de Kol 2nd Homestead Fobes** (imp. to N.Z. from America) (341 N.Z.F.H.B.).

Dam's Record for 273 days under Government Herd Test—
11,512 lb. Milk, 4·08 Test, 479 lb. Butter Fat.

For Full Lactation Period—
13,898 lb. Milk, 4·24 Test, 589 lb. Butter Fat.

(2) Bull Calf *ex* Victoria Oakdale Lassie (996)

Dropped 24th September, 1923

Sire: **Victoria Jo Patch (345)** by Longbeach Big Patch (515 N.Z.F.H.B.), *ex* Dominion Madrigal (371).

Sire of Dam: **Dominion Oakdale (342)** by Oak de Kol 2nd Homestead Fobes.

Vict. Oakdale Lassie is now undergoing her 1st test.

Her Dam, Dominion Proud Lassie's Record for 273 days under Government Herd Test—
11,336 lb. Milk, 3·42 Test, 387 lb. Butter Fat.

For Full Lactation Period—
12,216 lb. Milk, 3·51 Test, 428 lb. Butter Fat.

(3) Bull Calf *ex* Dominion Woodnymph (938)

Dropped November, 1923

Sire: **Victoria Jo Patch (345)** by Longbeach Big Patch (515 N.Z.F.H.B.), *ex* Dominion Madrigal (371).

Sire of Dam: **Woodcrest Jo** (imp. to N.Z. from America) (334 N.Z.F.H.B.).

Dam's Record for 273 days under Government Herd Test—
10,610 lb. Milk, 3·17 Test, 336 lb. Butter Fat.

For Full Lactation Period—
13,240 lb. Milk, 3·31 Test, 439 lb. Butter Fat.

The record of the dam—DOMINION MADRIGAL—of the sires "Victoria Songboy" and "Victoria Jo Patch" for 273 days under Government Herd Test is 11,373 lb. Milk, 3·93 Test, 448 lb. Butter Fat; and for Full Lactation Period 13,485 lb. Milk, 4·17 Test, 563 lb. Butter Fat. "DOMINION MADRIGAL" is a full sister to "DOMINION QUEEN MERCEDES," third cow of all breeds under Government Herd Test 1923, and Winner "Weekly Times" Butter Competition, Melbourne Royal Show 1923, and Champion Melbourne Royal Show 1923.

(4) Cow "VICTORIA DUTCHMAID" - 4 years old
Sire: Dominion Domino Dutch Boy (73). *Dam:* Dominion Milkmaid (370).

(5) Heifer "VICTORIA BELLONA" - - 3 years old
Sire: Dominion Domino Dutch Boy (73). *Dam:* Dominion Belle Corona (369).

(6) Heifer "VICTORIA CORIANDER" - 3 years old
Sire: Dominion Domino Dutch Boy (73). *Dam:* Dominion Coringa (380).

Inspection of above Bull Calves and Heifers at the State Research Farm, Werribee, is invited.

Application for Purchase to—

DR. S. S. CAMERON, Director of Agriculture, MELBOURNE

DEPARTMENT OF AGRICULTURE, VICTORIA

Red Poll Dairy Herd

The Department has now completed the orders for calves that were booked ahead of calving when the advertisement was withdrawn; consequently the booking of orders for bull calves from the forthcoming calvings has now been resumed.

BULL CALVES are sold for delivery at a month old at prices based approximately on the actual milk and butter fat record of the dam at the rate of 1s. per lb. of butter ***fat*** yielded. Thus a calf from a cow with a 400 lbs. butter fat record is sold for 20 guineas, one from a 300 lb. butter fat cow for 15 guineas, and so on. Bull Calves *ex* heifers on their first calf are sold for a set price of 10 guineas.

(For Record of Yields of dams see Red Poll Herd Book.)

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Sire: Nicotine (69 A.A.). Dam: Velveteen (Imp.) 22875 (2 A.A.).

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Sire: Nicotine (69 A.A.) by Acton Dewstone (imp.) 9524 (4 A.A.).

Dam: Tonga (253 A.) by Honingham Archbishop (imp.) 9702 (48 A.A.).

Tonga's butter fat yields for 6 successive lactation periods are as follow:—1916, 341 lbs.; 1917, 398 lbs.; 1918, 419 lbs.; 1919, 479 lbs.; 1920, 428 lbs.; 1921, 562 lbs.

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Dam's Record (1st milking) 7144 lbs. milk.								
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G. Sire's D. Dam's	,,	10215	,,	...	7	,,	,,	9386 ,,
G.G. Sire's D. Dam's	,,	12565	,,	...	10	,,	,,	8853 ,,
G.G.G. Sire's D. Dam's	,,	10088	,,	...	2	,,	,,	9754 ,,

Inspection of the Herd is Invited.

Visitors will be met at the Station on notifying the Manager, State Research Farm, Werribee.

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Dark Bay Colt, rising 2 years—big, weighty, active colt (full of quality).

Dam; FAIRY (C.C.S.B., Vol. 1, Appendix A) by MAJOR OATES (285).
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BARON'S JESTER

Bay Colt, rising 2 years – thick, short legged, weighty colt.

Dam: JESS (C.C.S.B., Vol. 1, No. 400) by MAJOR OATES (285).
G.Dam: DARLING OF WERRIBEE (C.C.S.B., Vol. 1, 235) by BALGOWRIE (109 N.Z.C.S.B.).

BARON BELLIGERENT

Bay Colt, rising 2 years—well developed weighty colt.

Dam: BELLE (C.C.S.B., Vol. 1, No. 88) by AGITATOR (Imp.) (10488 C.S.B.).
G.Dam: KATE, by CROWN PRINCE (145 A.C.S.B.) (712 C., A.D.H.S.B.).

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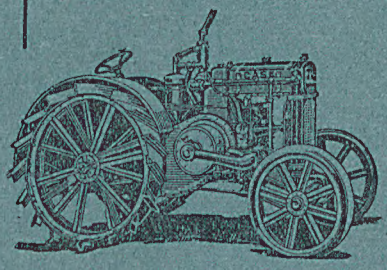

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